W2 VERSION 3.71 RELEASE NOTES

April 9, 2015

The code, updates and further information on the W2 model are available from the following web page (subject to change):

http://www.ce.pdx.edu/w2

Please address questions about the code to

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W2 V3.7 RELEASE PACKAGE

The current release of the model includes the w2 model and preprocessor executables, source codes, user manuals, and example applications.

The model files are in 1 zipped file: **v37.zip**. Contents of this file are organized in the following subdirectories and files:

- **Examples** – Model application examples include DeGray Reservoir, Spokane River, and Columbia Slough estuary.
- **Executables** – The executables for the preprocessor and the model in this directory were compiled using Intel Fortran 12.1 compiler and have both 32- and 64-bit versions.
- **W2ControlGUI** - The W2Control GUI was compiled using Visual Basic 6. The GUI directory also has an installation routine for W2Control. There is a "setup.exe" routine that installs the Visual Basic W2 V3.7 Model Preprocessor called W2CONTROL. Once installed, the GUI preprocessor is able to aid the model user in setting up the Control File and in evaluating and changing the bathymetry of the system. This preprocessor does not automatically set-up the bathymetry of the system, nor does it provide post-processing support. A lot of effort is required to properly set-up the model bathymetry prior to using the Bathymetry editor within W2Control. A user manual in pdf format is included in this directory. Also, a separate executable, W2Control, is provided in case an earlier version has already been installed. Note that this GUI is a part of the install routine for W2Tools now.
- **W2Tools** – This is the new W2 post-processor by Dynamic Solutions-International, LLC (www.ds-international.biz). They have provided an installation routine that includes both the post-processor and the W2ControlGUI. When the user selects W2L output (the old VPL output), the resulting post-processing file is used by W2Tool for all post-processing tasks that include contour plots, animations, profile plots and time series plots. A brief user manual is included showing many of the features of this post-processor as well as a directory that shows how to take field data and plot field data and model results in the post-processor. There is a zip file with an example from DeGray reservoir on how to include model predictions versus field data for reservoir profiles.
- **Source** – This directory contains the source code for the preprocessor and model written in Fortran. The compiler settings and files necessary to compile using the Intel compiler are also included using the Intel Fortran compiler. Generally, we use the following compiler settings: /O2 [maximum speed in Intel] and default real is double precision. Also, for the following subroutines we had to use /O1 optimization: init-cond.f90 and init-u-elws.f90. For the preprocessor, the windows source code is compiled using a QuickWin application rather than a console application. We use the debug version for the released executable. The generic preprocessor code should work compiled as a console application.

- **Waterbalance** – This is the windows waterbalance utility that is described in the user manual. The purpose of this code is to approximate the waterbalance for a reservoir or lake by computing flows (positive and negative) that will allow the model predicted water level to agree to water level data for a reservoir.
- **Excel macro utility for writing files in W2 format from Excel -** This directory contains an Excel macro that aids in writing our CE-QUAL-W2 compatible files from within Excel. There is a short user manual describing how to use the macro. This macro was developed by Jeffrey Gregory, Civil Engineer, USACE, Nashville District.
- **W2V3_manual371_revX.pdf** - User Manual in searchable pdf format where X is the rev number.
- **W2_Version_3.71_Release_Notes.pdf** - Release notes in pdf format.

W2 KNOWN ISSUES

The following list shows known bugs and issues with the current release of the code - these are being addressed in the next release:

#	Item	Description
1	Water levels in a "bowl"	If water levels decrease in a waterbody shaped like a "bowl", the removal of model layers as the water level decreases will cause the model to bomb if an upstream segment dries up.
2	Pipes under high head	The pipes algorithm does not handle well high-head, high-speed, dynamic flow conditions in a pipe.
3	Time step limitation in a complex system model	The time step for stability in a system model is governed by the lowest time step for numerical stability. If you have a very dynamic river with several reservoirs, the time step for the river will control. This can result in very long run times. One can still break apart the model and run the pieces separately using the WDOUT files to provide boundary conditions for downstream waterbodies.
4	Partitioning	The partitioning coefficient for sorption is currently constant for all organic and inorganic compartments
5	Internal weir at a Dam segment	Putting an internal weir at a Dam segment does not affect the outflow from the selective withdrawal structure. One must limit selective withdrawal rather than use an internal weir at the dam segment. Remember the internal weir works for the right-hand-face of a model layer.

#	Item	Description
6	W2 multiple file error check	If the model user accidentally enters duplicate file names for an input file, the w2 executable will "bomb" because it will try to read the file in more than once. The first use of the file will lock its availability for the second instance. The W2 error message that comes on the screen (traceback error) should mention the file name that has problems. The W2 preprocessor should catch this potential error.
7	Raising level of spillway/weir above grid	The preprocessor will say there is an error if the user raises the weir, spillway, gate, water level control or any other hydraulic element above the current top-of-the-grid. The w2 code will still run properly though. But more correctly, the model user should increase the DZ of the upper-most layer to a value that would eliminate this problem. But keep in mind that the segment widths from the top layer then extend upward at that same width.
8	Internal weirs	The internal weir algorithm does not work when all vertical layers of a segment are blocked by the weir.
9	Multiple dams into one downstream reach	Currently, the code will allow one dam inflow to a downstream branch by a user-specified outflow file. The code though does allow multiple dams inflowing to a common downstream branch if the outflow is specified as a hydraulic structure.
10	Problems reading file in GUI	Sometimes the control file or bathymetry file cannot be read properly by the GUI interface. This can be a result of the text editor used to produce the file. [You will find that the problem file(s) look all messed up in NOTEPAD but look OK in the PFE Editor or in WORD; and W2 usually can read them OK.] Sometimes the following will “fix” the formatting: Copy the file to a UNIX workstation and copy it back. Load the file in WORD as a Text file, add a space somewhere in the file (but don’t mess up the file formatting), then save it as a Text file. Convert all tabs to ‘spaces’

W2 V3.7 Bug Fixes, Enhancements, and User Manual Changes

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

1	W2	Fish habitat limits	Changed temperature and DO criteria from
			
			`t2(k,i)<fishtemph(ii).and.t2(k,i)>fishtempl(ii).and.o2(k,i)>fishdo(ii)`
			
			to
			
			`t2(k,i)<=fishtemph(ii).and.t2(k,i)>fishtempl(ii).and.o2(k,i)>=fishdo(ii)`
			
			This update is reflected in the manual. Hence the high temperature limit and the dissolved oxygen minimum is less than or equal to given value rather than less than.
				8/7/2012

2	W2	Structure, gate, pump, pipe, withdrawal output files	Added code to ensure that if flow is '0' in an outlet structure, that the corresponding temperature and concentration in the outlet file is written as '-99.0'. Previously this was not fully implemented in the code. Code such as this was inserted in several places in the subroutine outputa2.f90:
			
			`IF(QGT(JS)==0.0)THEN`
			`TAVGW(JWD)=-99.0`
			`CAVGW(JWD,:)=-99.0`
			`CDAVGW(JWD,:)=-99.0`
			`ENDIF`
				8/13/2012

3	PREW2	Format updates	Several output updates were made for warnings and errors	8/16/2012
4	Resource files for W2	Compiling files	Updated some corrupted resource files that were used to compile the source code. Also, zipped up source code and compiler settings together so that file locations are correct for using the Intel compiler.	9/12/2012

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
5	W2 and PREW2	Read csv files	By inserting the character '$' as the first character of the first line, the following files can now be read in free-format or csv format: met, lpr, vpr, wsc, met, cin, ctr, cdtr, cpre, qot, and qwd. This is described in a Word document that accompanies the download package. The preprocessor has also been updated for file checks. This is part of the Version 3.71 update.	9/12/2012

6	W2	Read input file	An input format bug was fixed for a system with more than 9 waterbodies.
			
			`DO JD=1,NDC`
			`!READ (CON,'(A8,(:9A8))') CDNAME2(JD),(CDWBC(JD,JW), JW=1,NWB)`
			`READ (CON,'(A8,(:9A8):/(8X,(:9A8)))') CDNAME2(JD),(CDWBC(JD,JW), JW=1,NWB)`
			`!cb 9/13/12`
			`END DO`
			`READ (CON,'(/)')`
			`! DO JF=1,NFL`
			`do jf=1,73 ! Fix this later`
			`!READ (CON,'(A8,(:9A8))') KFNAME2(JF),(KFWBC(JF,JW), JW=1,NWB)`
			`READ (CON,'(A8,(:9A8):/(8X,(:9A8)))') KFNAME2(JF),(KFWBC(JF,JW), JW=1,NWB)`
			`!cb 9/13/12`
			`END DO`
			
			This had the effect of turning OFF output for derived constituents for waterbody 10.
				9/13/2012

7	GUI	Time series elevation	The GUI read in values of ETSR as integers rather than real numbers. This was fixed.	10/30/12
8	W2	Spillways Lateral	Lateral spillways when connected to other model segments were sometimes not connecting as a tributary to the downstream segment. This has been fixed.	10/30/12
9	W2	W2Tools output	In place of the Vector Plot Output (VPL), a new output was added that allows use of the W2Tools post-processing package. This is part of the Version 3.71 update.	10/30/12
10	W2	User Manual	The User Manual has been updated with the new model features as shown in 5 and 9 above. In addition a separate user manual file shows how to use the w2tools post-processor. This is in the directory for W2tools. This is the version 3.71 update.	10/30/12

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
11	W2	Water quality and temperature	A new calculation technique was added that eliminates calling the Tri-diagonal subroutine. These were built into the temperature and water quality subroutines. This change results in improvements in computational speed of from less than 5% to over 20% for water quality models with lots of water quality state variables.	10/30/2012
12	PREW2	More checks	Added more error trapping for input files. This is an effort for the error trapping to occur before the code bombs. Fixed a couple of regression errors as a result of this fix.	11/2/2012, 11/5/2012
13	Excel macro utility		Added an Excel macro utility to aid in writing out input files to CE-QUAL-W2	11/5/2012

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

14	W2	Withdrawal subroutine	Fixed an IF test that used the wrong variable in the dynamic port allocation algorithm. Also added code to allow the code to test for temperatures at the outlet levels specified.
			
			Deleted line of code is underlined followed by the fix.
			
			DO J=1,NUMTSPLT !REODERING OUTLETS SO THAT HIGHEST ELEVATION STRUCTURE ON TOP (ASSUMING 2 SPLIT OUTLETS)
			! IF(TCNTR(J) == ' ST')THEN
			IF(TSPLTCNTR(J) == ' ST')THEN
			! cb 11/11/12
			IF(ESTR(JSTSPLTT(J,1),TSPLTJB(J)) < ESTR(JSTSPLTT(J,2),TSPLTJB(J)))THEN
			JSTSPLT(J,1)=JSTSPLTT(J,2)
			JSTSPLT(J,2)=JSTSPLTT(J,1)
			END IF
			! ELSE IF(TCNTR(J) == ' WD')THEN
			ELSE IF(TSPLTCNTR(J) == ' WD')THEN
			! cb 11/11/12
			IF(EWD(JSTSPLTT(J,1)) < EWD(JSTSPLTT(J,2)))THEN
			
			…
			IF(TSPLTJB(J) == JB .AND. TSPLTCNTR(J) == ' ST')THEN
			QALL=0.0
			DO JJ=1,NOUTS(J)
			
			QALL=QALL+QSTR(JSTSPLT(J,JJ),TSPLTJB(J)) ! SUM UP ALL THE FLOWS
			ELR = SINA(JB)*DLX(DS(JB))*0.5
			DO K=KTWB(JW),KB(DS(JB))
			IF (EL(K,DS(JB))-ELR < ESTR(JSTSPLT(J,JJ),TSPLTJB(J))) EXIT !SW 10/17/01
			END DO
			KSTR = K-1
			KSTRSPLT(JJ) = MIN(KSTR,KB(DS(JB)))
			ENDDO
			DO JJ=1,NOUTS(J) ! cb 11/11/12 dividing total flow between outlets for temperature test
			
			QSTR(JSTSPLT(J,JJ),TSPLTJB(J)) = qall/real(nouts(j))
			ENDDO
				11/13/12

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

15	W2	Reading in names of WQ variables	In case a user does not enter the units in graph.npt, the code improperly parses the WQ variable name. In this case the output name is a blank. To avoid this issue, extra code was added to preserve the variable name even if no units were added to the graph.npt list.
			
			`L1 = SCAN (CNAME(JC),',')+2`
			`IF(L1 == 2)L1=43 ! SW 12/3/2012 Implies no comma found`
			`L2 = SCAN (CNAME(JC)(L1:43),' ')+L1`
			`IF(L2 > 43)L2=43 ! SW 12/3/2012`
			`CUNIT(JC) = CNAME(JC)(L1:L2)`
			`CNAME1(JC) = CNAME(JC)(1:L1-3)`
			`CNAME3(JC) = CNAME1(JC)`
			`DO WHILE (L3 < L1-3)`
				12/3/2012

16	PREW2	SEDS and SEDK	The variable names were switched in reading the control file in the preprocessor perhaps leading to incorrect warnings/errors being tagged.
			
			The proper order was restored:
			`!READ (CON,'(/A8/(8X,2A8,6F8.0,A8))', ERR=400) AID, (SEDC(JW), PRNSC(JW), SEDCI(JW), seds(jw), SEDDK(JW), FSOD(JW), &`
			`!`
			`FSED(JW), sedbr(jw), DYNSEDK(JW), JW=1,NWB)`
			`! SW 6/1/07`
			`READ (CON,'(/A8/(8X,2A8,6F8.0,A8))', ERR=400) AID, (SEDC(JW), PRNSC(JW), SEDCI(JW), SEDDK(JW),seds(jw), FSOD(JW), &`
			
			`FSED(JW), sedbr(jw), DYNSEDK(JW), JW=1,NWB)`
			`! cb 12/30/12`
				12/30/12

17	Excel macro utility w2tool	Integer/Long variables	Some loose ends were corrected in the Visual Basic code built into the Excel macros.	1/2/2013

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
18	W2	TDG output	A series of code changes were made to fix some issues that arose for computing the impact of a structure on downstream TDG. These fixes were made in subroutines Withdrawal, outputa2w2tools, w2modules, and hydroinout. These affected calculation of output of dissolved gas concentration for output files for spillways or gates that had dissolved gas equation.	1/23/2013

19	W2	Reading in dynamic extinction coefficient	For temperature only studies, the model did not update the dynamic light extinction coefficient correctly. This has been fixed by the added code below:
			
			`DO JW=1,NWB`
			`IF (READ_EXTINCTION(JW))GAMMA(:,US(BS(JW)):DS(BE(JW))) = EXH2O(JW) ! SW 1/28/13`
			`KT = KTWB(JW)`
			`IF (.NOT. NO_HEAT(JW)) THEN`
				1/28/2013

20	W2	Input format when 9 WBs	A specific input read error occurred when 9 waterbodies were present as a result of an earlier bug fix: The new read statements occur in 2 places:
			
			`READ (CON,'(A8,9A8,/(:8X,9A8)))')`
			`CDNAME2(JD),(CDWBC(JD,JW), JW=1,NWB)`
			`!cb 9/13/12 sw 2/18/13`
			
			`READ (CON,'(A8,9A8,/(:8X,9A8)))')`
			`KFNAME2(JF),(KFWBC(JF,JW), JW=1,NWB)`
			`!cb 9/13/12 sw2/18/13`
				2/18/13

21	PREW2	More checks added	Additional checks were added to warn users of gaps in meteorological data when interpolation may be inappropriate.	2/20/2013
22	W2 User Manual	Updated	Updated User Manual – many small additions and edits – REV3.	2/20/2013
23	PREW2	Improved an error check	Updated an error check for choosing inactive segments for ISNP output	3/21/2013
24	PREW2	More checks added	Added checks for inflow temperature and tributary temperatures	3/28/2013

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

25	W2	Initial WL Calculation	Changed SLOPE to SLOPEC in init—u-elws.f90 routine since the normal depth should be based on SLOPEC.
			
			`END IF`
			`FUNCVALUE=FLOW-XAREA*HRAD**0.6667*SLOPEC(JB)**0.5/FMANN`
			`! SW 4/5/2013`
			
			`RETURN`
			`END SUBROUTINE MANNINGS_EQN`
			
			Also changed KB(I)-1 to KB(I)+1 for ELWS:
			
			`IF(ABS(DX).LT.XACC .OR. FMID.EQ.0.)THEN`
			`ELWS(I)=RTBIS+EL(KB(I)+1,I)`
			`! SW 4/5/13`
			`RETURN`
			
			Also changed KTTOP from REAL to an INTEGER:
			`REAL :: XAREA, WSURF ! 4/5/13 SW`
			`INTEGER :: KTTOP ! 4/5/13 SW`
				4/5/2013

25	W2	Output for pumps, spillways, gates	If the LAT option was chosen, the output files index for JWD was incorrect. This may have affected output temperatures and concentrations.	5/17/2013
26	PRE-W2	Mass loading calculation	There were cases where the preprocessor bombed while calculating the mass loading for output to the pre.opt file. This error has been fixed.	6/21./2013

27	W2	Assorted code updates	Minor format errors (that were ignored by compiler), update to code comments, and faster code initializations to speed up model performance were performed in several subroutines: input_PAR.f90, temperature_PAR.f90, transport_PAR.f90, update.f90, and w2_37_win.f90.
			
			An example of an initialization code speed up from temperature_PAR.f90:
			
			New code:
			`DO K=KT,KB(I)`
			`AT(K,I) = 0.0D0; CT(K,I) = 0.0D0; VT(K,I) = 0.0D0`
			`! SW CODE SPEEDUP 6/15/13`
			`ENDDO`
			
			Old code
			`AT(:,I) = 0.0D0; CT(:,I) = 0.0D0; VT(:,I) = 0.0D0`
				6/21/2013

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
28	W2 tools Excel macro	Update	More robust tools release	6/21/2013
29	PRE-W2	Label error	A label error for one spillway error was fixed. It mistakenly used 'gate'.	7/2/2013

30	W2	CPL output	A slight change in output format for the 'raw' cpl output file format was made. No change was made in the tecplot output format.
			`DO I=CUS(JB),DS(JB)`
			`WRITE (CPL(JW),'(A38/(9(F10.3,2X)))') CDNAME(CDN(JD,JW)),(CD(K,I,CDN(JD,JW))*CDMULT(CDN(JD,JW)), K=KTWB(JW),KB(I)) ! cb 6/28/13`
			`end do`
			`!WRITE (CPL(JW),'(A38/(9(F10.3,2X)))') CDNAME(CDN(JD,JW)),((CD(K,I,CDN(JD,JW))*CDMULT(CDN(JD,JW)), & ! SW 8/12/06`
			`!K=KTWB(JW),KB(I)),I=CUS(JB),DS(JB)) ! CB 1/03/05`
				7/31/13

31	W2	Read input file	A regression error that cropped up when there were 9 or greater than 10 waterbodies has been fixed. This had to do with reading in derived and flux variables in the control file.
			`DO JD=1,NDC`
			`If(nwb < 10)READ (CON,'(A8,(:9A8))') CDNAME2(JD),(CDWBC(JD,JW), JW=1,NWB)`
			`If(nwb >= 10) READ (CON,'(A8,9A8,/(:8X,9A8))') CDNAME2(JD),(CDWBC(JD,JW), JW=1,NWB)`
			`!cb 9/13/12 sw 2/18/13 6/16/13`
			`END DO`
			`READ (CON,'(/)')`
			`! DO JF=1,NFL`
			`do jf=1,73 ! Fix this later`
			`If(nwb < 10)READ (CON,'(A8,(:9A8))') KFNAME2(JF),(KFWBC(JF,JW), JW=1,NWB)`
			`If(nwb >= 10) READ (CON,'(A8,9A8,/(:8X,9A8))') KFNAME2(JF),(KFWBC(JF,JW), JW=1,NWB)`
			`!cb 9/13/12 sw2/18/13 6/16/13`
				8/13/13

32	W2	New compiler	Upgraded to the Intel XE 13.1.3.198 compiler. New W2 executables for 32 bit and 64 bit.	8/13/13

33	W2	INIT WL	An error was fixed in the initial water level computation program for rivers. The code below should have the subscript JB instead of J.
			`DO JJW=1,NWB`
			`DO JJB=BS(JJW),BE(JJW)`
			`IF(DHS(JB) > US(JJB) .AND. DHS(J) < DS(JJB))THEN`
			`JBD=JJB`
			`END IF`
			`END DO`
				8/20/13

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

34	W2	INIT WL	There was an index error with gates in the initial water level computation. The old code is shown below:
			
			`IF(ELWS(ID) < WSUP)THEN`
			`IF(ELWS(IDSP(JS)) > WSUP) WSUP = ELWS(IDSP(JS)) ! CHECKING TO SEE IF DOWNSTREAM WS ELEVATION ISN'T ALREADY 'HIGH'`
			`ELWS(ID)=WSUP`
			
			The new code is
			
			`IF(ELWS(IDGT(JG)) > WSUP) WSUP = ELWS(IDGT(JG)) ! CHECKING TO SEE IF DOWNSTREAM WS ELEVATION ISN'T ALREADY 'HIGH' WX 8/21/13`
				8/21/2013

35	W2	GATE	Cleaning up some code in the gate algorithm.
			Old code:
			
			`IF (A2GT(JG) /= 0.0 .AND. IDGT(JG) /= 0.0) THEN`
			
			New code:
			
			`IF (A2GT(JG) /= 0.0 .AND. IDGT(JG) /= 0) THEN`
				8/21/2013

36	W2	TSS computation	Updated the computation for the derived variable TSS to include zooplankton and the particulate form of CBOD. A formula was added to the User Manual reflecting this change. New code includes
			
			`IF(CBODS(IBOD)>0.0)TOTSS(K,I) = TOTSS(K,I)+CBOD(K,I,IBOD)/O2OM(JW)`
			`! SW 9/5/13 Added particulate CBOD to TSS computation`
			
			`TOTSS(K,I) = TOTSS(K,I)+ZOO(K,I,JZ) ! SW 9/5/13 Added zooplankton to TSS computation`
				9/6/2013

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

37	W2	Spillway-LAT	When a spillway was defined with IDSP=0 and LAT, a tributary was defined incorrectly. The new code is shown below:
			
			`IF (IDSP(JS) /= 0)then  ! cb 9/11/13`
			`JTT = JTT+1`
			`QTR(JTT) = QSP(JS)`
			`ITR(JTT) = IDSP(JS)`
			`PLACE_QTR(JTT) = PDSPC(JS) == 'DENSITY'`
			`SPECIFY_QTR(JTT) = PDSPC(JS) == 'SPECIFY'`
			`IF (SPECIFY_QTR(JTT)) THEN`
			`ELTRT(JTT) = ETDSP(JS)`
			`ELTRB(JTT) = EBDSP(JS)`
			`END IF`
			`JBTR(JTT) = JBD`
			`end if  ! cb 9/11/13`
				9/11/2013

38	W2	32 bit exe on XP	Recompiled with new settings from Visual Studio 2012 to (hopefully) run on XP systems with 32 bit OS	9/11/2013

39	W2	End Simulation	Added new close open files in the end_simulation subroutine. This is merely cleaning up the code to be consistent in closing all open files when a 'Stop' is executed. This should have no effect on the end user. Part of this new code is shown below:
			`IF(SELECTC == '  ON')then  ! SW 9/25/13 New Section on closing files`
			`ifile=1949`
			`do jb=1,nbr`
			`if(nstr(jb) > 0)then`
			`ifile=ifile+1`
			`close(ifile)`
			`endif`
			`enddo`
			`if(nwd > 0)then`
			`ifile=ifile+1`
			`close(ifile)`
			`endif`
			`endif`
			
			`IF (DOWNSTREAM_OUTFLOW) THEN`
			`JFILE=0`
			`DO JWD=1,NIWDO`
			`CLOSE(WDO(JWD,1))`
			`CLOSE(WDO(JWD,2))`
			`IF (CONSTITUENTS) THEN`
			`CLOSE (WDO(JWD,3))`
			`END IF`
			`IF (DERIVED_CALC) THEN`
			`CLOSE(WDO(JWD,4))`
			`END IF`
				9/25/13

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

40	W2	Pumps – Lateral	Fixed several sections of code in the PUMP algorithm in the hydroinout.f90 routine. Under some conditions such as specifying "Lateral", the PUMP algorithm may not have moved the water from the upstream to the downstream segment correctly. This has been fixed and tested. Part of the code changes are shown below:
			`IF (LATERAL_PUMP(JP)) THEN`
			`ELW = EL(KTWB(JWU),IUPU(JP))-Z(IUPU(JP))*COSA(JBU)`
			`! JWW = JWW+1 ! SW 9/25/13`
			`! JBWD(JWW) = JBU`
			`! IWD(JWW) = IUPU(JP)`
			`ELSE`
			`ELW = EL(KTWB(JWU),IUPU(JP))-Z(IUPU(JP))*COSA(JBU)-SINA(JBU)*DLX(IUPU(JP))*0.5`
			`! JSS(JBU) = JSS(JBU)+1 ! SW 9/25/13`
			`END IF`
			…
			`IF (PUMPON(JP)) THEN`
			`IF (LATERAL_PUMP(JP)) THEN`
			`JLAT = 1`
			`JWW = JWW+1`
			`! SW 9/25/13`
			…
			`CALL LATERAL_WITHDRAWAL ! (JWW)`
			`DO K=KTW(JWW),KBW(JWW)`
			`QSS(K,I) = QSS(K,I)-QSW(K,JWW)`
			`END DO`
			`IF (IDPU(JP) /= 0) THEN`
			`! MOVED CODE SW 9/25/13`
			`JTT = JTT+1`
			…
			`ELSE`
			`JSS(JBU) = JSS(JBU)+1 ! SW 9/25/13`
			`KTSW(JSS(JBU),JBU) = KTPU(JP)`
			…
				9/25/13

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

41	W2	Clean up memory issues	A series of minor memory issues were cleaned up. This should have no impacts on current model runs. These were usually uninitialized memory. Code changes made include:
			
			`READ (CON,'(/)')`
			`  KFNAME2='     '   ! SW 9/27/13 INITIALIZE ENTIRE ARRAY`
			`  KFWBC   ='     '   ! SW 9/27/13 INITIALIZE ENTIRE ARRAY`
			
			`READ (CON,'(//(:8X,9I8))')          (KBWD(JW), JW=1,NWD); TRC= '       '  ! SW 9/27/13 INITIALIZATION SINCE ALLOCATION IS TO NTRT`
			`  READ (CON,'(//(:8X,9A8))')          (TRC(JT), JT=1,NTR)`
			
			`    EHSN(JE),   EHSSI(JE), JE=1,NEPT)        !JE=1,NEP)  SW 9/27/13`
			`  READ (CON,'(//(8X,2F8.0,I8,F8.0))') (ESAT(JE), EHS(JE),    ENEQN(JE),  ENPR(JE), JE=1,NEPT)        !JE=1,NEP)  SW 9/27/13`
			`  READ (CON,'(//(8X,8F8.0))')         (ET1(JE), ET2(JE),    ET3(JE),    ET4(JE),    EK1(JE), EK2(JE),                          &`
			`                                        EK3(JE), EK4(JE), JE=1,NEPT)        !JE=1,NEP)  SW 9/27/13`
			`  READ (CON,'(//(8X,6F8.0))')         (EP(JE), EN(JE),     EC(JE),     ESI(JE),    ECHLA(JE), EPOM(JE),    JE=1,NEPT)        !JE=1,NEP)  SW 9/27/13`
			
			`READ (CON,'(//8X,A8,I8,A8)')         RSOC, NRSO,    RSIC; RSOD=0.0 ! SW 9/27/13 INITIALIZE SINCE ALLOCATED AS NOD BUT ONLY NRSO USED`
			`  READ (CON,'(//(:8X,9F8.0))')        (RSOD(J), J=1,NRSO)`
			
			`  READ (CON,'(//8X,I8,F8.0,a8)')         NDLT, DLTMIN, DLTINTER; DLTD=0.0  ! SW 9/28/13 INITIALIZE ARRAY TO NOD SINCE ONLY NDLT ASSIGNED`
			`  READ (CON,'(//(:8X,9F8.0))')        (DLTD(J), J =1,NDLT)`
			
			`   SINKC(1:NSTR(JB),JB) = SINKCT(1:NSTR(JB),JB)`
			`    POINT_SINK(1:NSTR(JB),JB) = SINKC(1:NSTR(JB),JB) == '   POINT'   ! SW 9/27/13`
			`  END DO`
			` ! POINT_SINK = SINKC == '   POINT'`
			
			`  COLDEP=ELWS(I)-COLB`
			`   !     MACT(J,KT,I)=MACT(J,KT+1,I)`
			`  IF(MACROPHYTE_ON)MACT(J,KT,I)=MACT(J,KT+1,I) ! SW 9/28/13`
			
			`!     SDKV(:,US(JB):DS(JB))=SDK(JW)`
			`       SDKV(:,US(JB)-1:DS(JB)+1)=SDK(JW)    ! SW 9/28/13`
				9/27/13

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
42	W2	CPL output	Code was added to eliminate writing out the habitat index to the CPL file for Tecplot when HABITATC is OFF.	9/28/13

```
IF(I /= DS(JB)+1)THEN
                IF(HABTATC  == '      ON')THEN
                  WRITE (CPL(JW),9999)
X1(I),ELWS(I),U(K,I),-
W(K,I),T1(K,I),RHO(K,I),HAB(K,I),(C2(K,I,CN(JC))
,JC=1,NAC)
                ELSE
                  WRITE (CPL(JW),9999)
X1(I),ELWS(I),U(K,I),-
W(K,I),T1(K,I),RHO(K,I),(C2(K,I,CN(JC)),JC=1,NAC
)
                ENDIF

              ELSE
                XDUM=-99.0
                WRITE (CPL(JW),9999)
X1(I),ELWS(I),XDUM,XDUM,XDUM,XDUM,XDUM,(XDUM,
JJ=1,NAC)
              ENDIF
              DO K=KTWB(JW),KMX-1
                IF(I /= DS(JB)+1 .AND. K <=
KB(I))THEN
                IF(HABTATC  == '      ON')THEN
                  WRITE (CPL(JW),9999)
X1(I),ELWS(I)-DEPTHM(K,I),U(K,I),-
W(K,I),T1(K,I),RHO(K,I),HAB(K,I),(C2(K,I,CN(JC))
,JC=1,NAC)
                ELSE
                  WRITE (CPL(JW),9999)
X1(I),ELWS(I)-DEPTHM(K,I),U(K,I),-
W(K,I),T1(K,I),RHO(K,I),(C2(K,I,CN(JC)),JC=1,NAC
)
                ENDIF

                  IF(K == KB(I))THEN
                      IF(HABTATC  == '
ON')THEN
                    WRITE (CPL(JW),9999)
X1(I),ELWS(I)-DEPTHB(K,I),U(K,I), -
W(K,I),T1(K,I),RHO(K,I),HAB(K,I),(C2(K,I,CN(JC))
,JC=1,NAC)
                      ELSE
                    WRITE (CPL(JW),9999)
X1(I),ELWS(I)-DEPTHB(K,I),U(K,I), -
W(K,I),T1(K,I),RHO(K,I),(C2(K,I,CN(JC)),JC=1,NAC
)
                      ENDIF

WRITE (CPL(JW), *)'TITLE="CE-QUAL-W2"'
          IF(HABTATC  == '      ON')THEN
              WRITE
(CPL(JW),19233)(CNAME2(CN(JN)),JN=1,NAC)
          ELSE
              WRITE
(CPL(JW),19234)(CNAME2(CN(JN)),JN=1,NAC)
          ENDIF ! sw 9/28/13
               19233
FORMAT('VARIABLES="Distance, m","Elevation,
m","U","W","T","RHO", "HABITAT"
',<NAC>(',"',A8,'"'))
       19234 FORMAT('VARIABLES="Distance,
m","Elevation, m","U","W","T","RHO"
',<NAC>(',"',A8,'"')) ! sw 9/28/13
```

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

43	W2	SPECIFY TRIB	In specifying the elevation between top and bottom for an inflow tributary, the code put the inflow 1 layer below it should have been in many cases. This has been fixed by the additional code shown below:
			
			`IF (SPECIFY_QTR(JT)) THEN`
			`KTTR(JT) = 2`
			`! DO WHILE (EL(KTTR(JT),I) > ELTRT(JT))`
			`DO WHILE (EL(KTTR(JT),I) > ELTRT(JT) .and. EL(KTTR(JT)+1,I) > ELTRT(JT)) ! SW 10/3/13`
			`KTTR(JT) = KTTR(JT)+1`
			`END DO`
				10/3/2013

44	W2	CWO or CWDO output	Fixed a format overflow in writing out concentrations in a withdrawal output file.
			
			`IF (QWDO(J) /= 0.0) CWDO(CN(JC),J) = CWDO(CN(JC),J)/QWDO(J)`
			`WRITE (CWDOC(CN(JC)),'(F8.3)') CWDO(CN(JC),J) ! SW 9/23/13 Changed format from G8.3 to F8.3 to avoid format overflow`
			`CWDOC(CN(JC)) = ADJUSTR(CWDOC(CN(JC)))`
			
			`IF (QWDO(J) /= 0.0) CDWDO(CDN(JD,JW),J) = CDWDO(CDN(JD,JW),J)/QWDO(J)`
			`WRITE (CDWDOC(CDN(JD,JW)),'(F8.3)') CDWDO(CDN(JD,JW),J) ! SW 9/23/13 Changed format from G8.3 to F8.3 to avoid format overflow`
			`CDWDOC(CDN(JD,JW)) = ADJUSTR(CDWDOC(CDN(JD,JW)))`
				10/4/2013

45	W2 and PREW2	Inflow, Tributary, Distributary and Shade inputs	Added csv file format as a new file input format for flow and temperature files for inflows, tributaries and distributed tributaries. Also, the shade file is now in csv file format. This enhancement includes updates to the preprocessor and W2 codes. Also several minor bug fixes were made on the Preprocessor.	7/15/14

46	W2	Resuspension of inorganic solids	A resuspension formula was corrected. See the code change below:
			
			`HS = 0.283*U2/G*0.283*TANH(COEF1)*TANH(COEF2/TANH(COEF1))`
			`!TS = 2.0*PI*U2/G*1.2*TANH(COEF3)*TANH(COEF4/TANH(COEF3))`
			`TS = 2.0*PI*sqrt(U2)/G*1.2*TANH(COEF3)*TANH(COEF4/TANH(COEF3)) ! cb 5/9/14`
				7/15/14

47	W2	Tecplot output	When the user sets CPL output for Tecplot, the output format when HABITAC=OFF was incorrect. This has been fixed.	7/15/14

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

48	PREW2	Warnings	Fixed a name inconsistency for developing warnings for input concentrations
			
			`!    IF (NAME /= 'Residence time' .AND. NAME /= 'Water age') THEN`
			`          IF (NAME /= 'Residence time' .AND. NAME /= 'AGE') THEN     ! SW 7/15/14`
			`            CALL WARNINGS`
				7/15/14

49	W2	TSR filename	The filename in w2_con.npt for TSR is used for the output filenames. In order to account for complex paths that include more than one '.', the following change was made with the BACK=.TRUE. command which checks from the right-hand-side rather than left-hand-side of the character string
			
			`!       L1 = SCAN(TSRFN,'.')`
			`       L1 = SCAN(TSRFN,'.',BACK=.TRUE.)`
				8/22/14

50	PREW2	Hydraulic structure warnings	Added many new hydraulic structure warnings (gates, spillways, pumps, pipes, internal weirs) for cases where KBSTR was less than KB and fixed a few error messages for these structure checks.	9/10/14
51	W2	TSR output	The time series file has added the surface heat flux terms (net, short wave solar net, long wave radiation net, back radiation heat flux, evaporation heat flux, conductive heat flux) to the output. The manual was also updated.	1/15/15

52	W2	Interpolation of wind direction	In some cases, the wind direction interpolation was incorrect. Code was added to reduce the wind direction angle to less than 2*pi before the interpolation is performed and to consider another possible interpolation case. Thanks to Wenwei Xu for pointing this out. New code is shown below:
			
			`       ! CONVERT PHIO AND PHINX TO LESS THAN 2*PI     SW 2/13/15`
			`      DO WHILE(PHIO(JW)>2.*PI)`
			`          PHIO(JW)=PHIO(JW)-2.*PI`
			`      ENDDO`
			`      DO WHILE(PHINX(JW)>2.*PI)`
			`          PHINX(JW)=PHINX(JW)-2.*PI`
			`      ENDDO`
			`      IF (PHIO(JW)-PHINX(JW) > PI) THEN`
			`        PHI(JW) = (1.0-RATIO)*(PHINX(JW)+2.0*PI)+RATIO*PHIO(JW)`
			`      ELSEIF (PHIO(JW)-PHINX(JW) < -PI) THEN ! WX 2/13/15`
			`        PHI(JW) = (1.0-RATIO)*PHINX(JW)+RATIO*(PHIO(JW) +2.0*PI)    ! WX 2/13/15`
			`      ELSE`
			`        PHI(JW) = (1.0-RATIO)*PHINX(JW)+RATIO*PHIO(JW)`
			`      END IF`
				2/13/15

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
53	W2	Restart output	Added code to write out a restart file (rso.opt) at the end of a run if restart_output is ON.	4/9/15

W2 PLANNED ENHANCEMENTS

The following list shows planned enhancements:

#	Item	Description
1	Sediment Diagenesis	Complex sediment diagenesis model
2	Simultaneous water level solution	Currently, water surface is solved branch-by-branch. The new technique will involve solving all water surfaces for the system or waterbody simultaneously.
3	W3	3D version of W2
4	Hypoheric flow algorithm	Groundwater-surface water interaction
5	Sediment channel bottom heating algorithm	Dynamic heat transfer between channel bottom and stream

Other items that have been explored but not implemented in the release version include:

1. A smarter fetch calculation algorithm
2. Updates to the selective withdrawal algorithm for multiple withdrawals
3. Particle transport algorithm
4. Fish bioenergetics model and fish volitional movement model

DIFFERENCES BETWEEN VERSION 3.71 AND VERSION 3.7

There is only one change in the control file between Version 3.7 and 3.71. There is a new option for outlet structures – dynamic centerline elevation. In the control file, there is an ON/OFF option after declaring the # of structures for each branch:

```
EDDY VISC    AZC   AZSLC   AZMAX     FBC       E   ARODI STRCKLR BOUNDFR  TKECAL
WB 1         TKE     IMP 1.00000       3 9.53500 0.43100 0.00000 0.00000     IMP

N STRUC     NSTR DYNELEV
```

```
BR1            17        ON
BR2             0       OFF
BR3             0       OFF

STR INT     STRIC    STRIC    STRIC    STRIC    STRIC    STRIC    STRIC    STRIC    STRIC
```

If these fields are missing the model will assume that DYNELEV=OFF.

DIFFERENCES BETWEEN VERSION 3.7 AND VERSION 3.6

Even though there are some cases where a Version 3.7 executable will run Version 3.6 and Version 3.5 files fine, there are updates required to the w2_con.npt file that need to be made. The preprocessor will catch these errors.

Control file changes: w2_con.npt

The main changes to the W2 control file are additional flags to turn ON/OFF new control file options and the addition of new state variables for water quality, BOD-N and BOD-P for each BOD group.

Below is a list of changes in the control file with the card image header for each line changed (highlighted options are new in V3.7). Descriptions of these new features are in the W2 User's Manual.

1. MISCELL

```
MISCELL      NDAY SELECTC HABTATC ENVIRPC AERATEC INITUWL
              100      OFF      ON      ON      ON     OFF
```

Five new variables, SELECTC, HABITATC, ENVIRPC, AERATEC, and INITUWL, are 5 new control variables that turn ON/OFF the use of automatic selective withdrawal, fish habitat volumes, environmental performance criteria, artificial aeration, and the initial water surface and velocity computations, respectively. If using an old Version 3.6 control file, all of these would default to 'OFF' if they were left blank. Also the model preprocessor would flag these are missing variables.

2. DLT CON

```
DLT CON       NDT   DLTMIN DLTINTR
                1 1.00000      OFF
```

where DLTINTR is a control for interpolating the the time step DLTMAX and DLTF rather than use as a step function

3. BRANCH G

```
BRANCH G      US       DS      UHS      DHS      UQB      DQB    NLMIN    SLOPE   SLOPEC
Br 1           2       59        0        0        0        0        1      0.0      0.0
```

where SLOPEC is the hydraulic equivalent slope for a river channel that affects the momentum equation.

4. GATE WEIR

```
GATE WEIR    GTA1     GTB1     GTA2     GTB2  DYNVAR     GTIC
Gate1     1.00000 1.50000 1.00000 1.50000    FLOW       ON
```

where GTIC is an interpolation control for the specified DYNVAR for the GATE-WEIR.

5. Dynamic pipe

```
PIPES       IUPI    IDPI    EUPI    EDPI     WPI   DLXPI     FPI  FMINPI  LATPIC DYNPIPE
Pi 1          24      28    28.0    27.0     0.5   230.0   0.065     0.1    DOWN      ON
```

where DYNPIPE controls whether the pipe is controlled by time series of an ON/OFF or partially open gate

6. Dynamic pump

```
PUMPS 1     IUPU    IDPU     EPU  STRTPU   ENDPU   EONPU  EOFFPU     QPU   WTHLC DYNPUMP
             111       0    440.    1.00    366.   441.0   435.0     1.0    DOWN      ON
```

where DYNPUMP controls the EPU, EONPU, EOFFPU, and QPU over time by reading in a time series file

7. INIT CND

```
INIT CND   TEMPI    ICEI  WTYPEC   GRIDC
WB 1     -1.0000 0.00000   FRESH    RECT
```

where GRIDC controls whether the grid is interpreted as rectangular in depth or trapezoidal.

8. CST ACTIVE [Note that this change only appears if NBOD>0]

```
CST ACTIVE   CAC
TDS           ON
Gen1          ON
Gen2         OFF
Gen3         OFF
Gen4         OFF
Gen5         OFF
ISS1          ON
PO4           ON
NH4           ON
NO3           ON
DSI          OFF
PSI          OFF
FE           OFF
LDOM          ON
RDOM          ON
LPOM          ON
RPOM          ON
1CBOD         ON
2CBOD         ON
3CBOD         ON
4CBOD         ON
5CBOD         ON
6CBOD         ON
7CBOD         ON
8CBOD         ON
9CBOD         ON
10CBOD        ON
1CBODP        ON
2CBODP        ON
```

```
3CBODP          ON
4CBODP          ON
5CBODP          ON
6CBODP          ON
7CBODP          ON
8CBODP          ON
9CBODP          ON
10CBODP         ON
1CBODN          ON
2CBODN          ON
3CBODN          ON
4CBODN          ON
5CBODN          ON
6CBODN          ON
7CBODN          ON
8CBODN          ON
9CBODN          ON
10CBODN         ON
ALG1            ON
ALG2            ON
ALG3            ON
DO              ON
TIC             ON
ALK             ON
ZOO1           OFF
LDOM_P          ON
RDOM_P          ON
LPOM_P          ON
RPOM_P          ON
LDOM_N          ON
RDOM_N          ON
LPOM_N          ON
RPOM_N          ON
```

9. CST ICON, CST PRIN, CIN CON,CTR CON, CDT CON and CPR CON

```
CST ICON    C2IWB    C2IWB    C2IWB    C2IWB    C2IWB    C2IWB    C2IWB    C2IWB    C2IWB
TDS           0.0
AGE           0.0
TRACER        0.0
COL1          0.0
Conduct       0.0
Chlorine      0.0
ISS1          0.0
PO4          0.03
NH4          0.01
NOx           0.3
DSi           0.0
PSi           0.0
TFe           0.0
LDOM          0.1
RDOM          0.1
LPOM          0.1
RPOM          0.1
1CBOD         0.0
2CBOD         0.0
3CBOD         0.0
4CBOD         0.0
5CBOD         0.0
6CBOD         0.0
7CBOD         0.0
8CBOD         0.0
```

```
9CBOD          0.0
10CBOD         0.0
1CBODP         0.0
2CBODP         0.0
3CBODP         0.0
4CBODP         0.0
5CBODP         0.0
6CBODP         0.0
7CBODP         0.0
8CBODP         0.0
9CBODP         0.0
10CBODP        0.0
1CBODN         0.0
2CBODN         0.0
3CBODN         0.0
4CBODN         0.0
5CBODN         0.0
6CBODN         0.0
7CBODN         0.0
8CBODN         0.0
9CBODN         0.0
10CBODN        0.0
ALG1           0.1
ALG2           0.1
ALG3           0.1
DO            12.0
TIC            5.0
ALK           19.8
ZOO1           0.0
LDOM_P      0.0005
RDOM_P      0.0005
LPOM_P      0.0005
RPOM_P      0.0005
LDOM_N      0.0080
RDOM_N      0.0080
LPOM_N      0.0080
RPOM_N      0.0080

CST PRIN   CPRWBC   CPRWBC   CPRWBC   CPRWBC   CPRWBC   CPRWBC   CPRWBC   CPRWBC   CPRWBC
TDS             ON
AGE             ON
TRACER          ON
COL1            ON
Conduct         ON
Chlorine        ON
ISS1            ON
PO4             ON
NH4             ON
NOx             ON
DSi            OFF
PSi            OFF
TFe            OFF
LDOM            ON
RDOM            ON
LPOM            ON
RPOM            ON
1CBOD           ON
2CBOD           ON
3CBOD           ON
4CBOD           ON
5CBOD           ON
6CBOD           ON
7CBOD           ON
```

```
8CBOD          ON
9CBOD          ON
10CBOD         ON
1CBODP         ON
2CBODP         ON
3CBODP         ON
4CBODP         ON
5CBODP         ON
6CBODP         ON
7CBODP         ON
8CBODP         ON
9CBODP         ON
10CBODP        ON
1CBODN         ON
2CBODN         ON
3CBODN         ON
4CBODN         ON
5CBODN         ON
6CBODN         ON
7CBODN         ON
8CBODN         ON
9CBODN         ON
10CBODN        ON
ALG1           ON
ALG2           ON
ALG3           ON
DO             ON
TIC            ON
ALK            ON
ZOO1          OFF
LDOM_P         ON
RDOM_P         ON
LPOM_P         ON
RPOM_P         ON
LDOM_N         ON
RDOM_N         ON
LPOM_N         ON
RPOM_N         ON

CIN CON   CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC
TDS            ON      ON
AGE           OFF     OFF
TRACER        OFF     OFF
COL1          OFF     OFF
Conduct        ON      ON
Chlorine      OFF     OFF
ISS1           ON      ON
PO4            ON      ON
NH4            ON      ON
NOx            ON      ON
DSi           OFF     OFF
PSi           OFF     OFF
TFe           OFF     OFF
LDOM           ON      ON
RDOM           ON      ON
LPOM           ON      ON
RPOM           ON      ON
1CBOD          ON      ON
2CBOD          ON      ON
3CBOD          ON      ON
4CBOD          ON      ON
5CBOD          ON      ON
6CBOD          ON      ON
```

```
7CBOD           ON       ON
8CBOD           ON       ON
9CBOD           ON       ON
10CBOD          ON       ON
1CBODP          ON       ON
2CBODP          ON       ON
3CBODP          ON       ON
4CBODP          ON       ON
5CBODP          ON       ON
6CBODP          ON       ON
7CBODP          ON       ON
8CBODP          ON       ON
9CBODP          ON       ON
10CBODP         ON       ON
1CBODN          ON       ON
2CBODN          ON       ON
3CBODN          ON       ON
4CBODN          ON       ON
5CBODN          ON       ON
6CBODN          ON       ON
7CBODN          ON       ON
8CBODN          ON       ON
9CBODN          ON       ON
10CBODN         ON       ON
ALG1            ON       ON
ALG2            ON       ON
ALG3            ON       ON
DO              ON       ON
TIC             ON       ON
ALK             ON       ON
ZOO1           OFF      OFF
LDOM_P          ON       ON
RDOM_P          ON       ON
LPOM_P          ON       ON
RPOM_P          ON       ON
LDOM_N          ON       ON
RDOM_N          ON       ON
LPOM_N          ON       ON
RPOM_N          ON       ON

CTR CON    CTRTRC   CTRTRC   CTRTRC   CTRTRC   CTRTRC   CTRTRC   CTRTRC   CTRTRC   CTRTRC
TDS             ON       ON
AGE            OFF      OFF
TRACER          ON       ON
COL1            ON       ON
Conduct         ON       ON
Chlorine        ON       ON
ISS1            ON       ON
PO4             ON       ON
NH4             ON       ON
NOx             ON       ON
DSi            OFF      OFF
PSi            OFF      OFF
TFe            OFF      OFF
LDOM            ON       ON
RDOM            ON       ON
LPOM            ON       ON
RPOM            ON       ON
1CBOD           ON       ON
2CBOD           ON       ON
3CBOD           ON       ON
4CBOD           ON       ON
5CBOD           ON       ON
```

```
6CBOD           ON       ON
7CBOD           ON       ON
8CBOD           ON       ON
9CBOD           ON       ON
10CBOD          ON       ON
1CBODP          ON       ON
2CBODP          ON       ON
3CBODP          ON       ON
4CBODP          ON       ON
5CBODP          ON       ON
6CBODP          ON       ON
7CBODP          ON       ON
8CBODP          ON       ON
9CBODP          ON       ON
10CBODP         ON       ON
1CBODN          ON       ON
2CBODN          ON       ON
3CBODN          ON       ON
4CBODN          ON       ON
5CBODN          ON       ON
6CBODN          ON       ON
7CBODN          ON       ON
8CBODN          ON       ON
9CBODN          ON       ON
10CBODN         ON       ON
ALG1            ON       ON
ALG2            ON       ON
ALG3            ON       ON
DO              ON       ON
TIC             ON       ON
ALK             ON       ON
ZOO1           OFF      OFF
LDOM_P          ON       ON
RDOM_P          ON       ON
LPOM_P          ON       ON
RPOM_P          ON       ON
LDOM_N          ON       ON
RDOM_N          ON       ON
LPOM_N          ON       ON
RPOM_N          ON       ON

CDT CON    CDTBRC   CDTBRC   CDTBRC   CDTBRC   CDTBRC   CDTBRC   CDTBRC   CDTBRC   CDTBRC
TDS             ON       ON
AGE            OFF      OFF
TRACER          ON       ON
COL1            ON       ON
Conduct         ON       ON
Chlorine        ON       ON
ISS1            ON       ON
PO4             ON       ON
NH4             ON       ON
NOx             ON       ON
DSi            OFF      OFF
PSi            OFF      OFF
TFe            OFF      OFF
LDOM            ON       ON
RDOM            ON       ON
LPOM            ON       ON
RPOM            ON       ON
1CBOD           ON       ON
2CBOD           ON       ON
3CBOD           ON       ON
4CBOD           ON       ON
```

```
5CBOD           ON       ON
6CBOD           ON       ON
7CBOD           ON       ON
8CBOD           ON       ON
9CBOD           ON       ON
10CBOD          ON       ON
1CBODP          ON       ON
2CBODP          ON       ON
3CBODP          ON       ON
4CBODP          ON       ON
5CBODP          ON       ON
6CBODP          ON       ON
7CBODP          ON       ON
8CBODP          ON       ON
9CBODP          ON       ON
10CBODP         ON       ON
1CBODN          ON       ON
2CBODN          ON       ON
3CBODN          ON       ON
4CBODN          ON       ON
5CBODN          ON       ON
6CBODN          ON       ON
7CBODN          ON       ON
8CBODN          ON       ON
9CBODN          ON       ON
10CBODN         ON       ON
ALG1            ON       ON
ALG2            ON       ON
ALG3            ON       ON
DO              ON       ON
TIC             ON       ON
ALK             ON       ON
ZOO1           OFF      OFF
LDOM_P          ON       ON
RDOM_P          ON       ON
LPOM_P          ON       ON
RPOM_P          ON       ON
LDOM_N          ON       ON
RDOM_N          ON       ON
LPOM_N          ON       ON
RPOM_N          ON       ON

CPR CON    CPRBRC   CPRBRC   CPRBRC   CPRBRC   CPRBRC   CPRBRC   CPRBRC   CPRBRC   CPRBRC
TDS             ON       ON
AGE            OFF      OFF
TRACER          ON       ON
COL1            ON       ON
Conduct         ON       ON
Chlorine        ON       ON
ISS1            ON       ON
PO4             ON       ON
NH4             ON       ON
NOx             ON       ON
DSi            OFF      OFF
PSi            OFF      OFF
TFe            OFF      OFF
LDOM            ON       ON
RDOM            ON       ON
LPOM            ON       ON
RPOM            ON       ON
1CBOD           ON       ON
2CBOD           ON       ON
3CBOD           ON       ON
```

4CBOD	ON	ON
5CBOD	ON	ON
6CBOD	ON	ON
7CBOD	ON	ON
8CBOD	ON	ON
9CBOD	ON	ON
10CBOD	ON	ON
1CBODP	ON	ON
2CBODP	ON	ON
3CBODP	ON	ON
4CBODP	ON	ON
5CBODP	ON	ON
6CBODP	ON	ON
7CBODP	ON	ON
8CBODP	ON	ON
9CBODP	ON	ON
10CBODP	ON	ON
1CBODN	ON	ON
2CBODN	ON	ON
3CBODN	ON	ON
4CBODN	ON	ON
5CBODN	ON	ON
6CBODN	ON	ON
7CBODN	ON	ON
8CBODN	ON	ON
9CBODN	ON	ON
10CBODN	ON	ON
ALG1	ON	ON
ALG2	ON	ON
ALG3	ON	ON
DO	ON	ON
TIC	ON	ON
ALK	ON	ON
ZOO1	OFF	OFF
LDOM_P	ON	ON
RDOM_P	ON	ON
LPOM_P	ON	ON
RPOM_P	ON	ON
LDOM_N	ON	ON
RDOM_N	ON	ON
LPOM_N	ON	ON
RPOM_N	ON	ON

New control files

Based on the options the user turns ON or OFF, new control files are required. These new control files are named:

1. w2_selective.npt – new variables controlling the selective withdrawal algorithm to select temperature targets
2. w2_habitat.npt – new variables controlling fish habitat limits for temperature and dissolved oxygen and surface and segment volume weighted eutrophication state variables
3. w2_envirpf.npt – new variables controlling setting environmental performance criteria
4. w2_aerate.npt – variables describing use of dissolved oxygen addition to enhance dissolved oxygen levels through diffusers

Details of these new control files are in the CE-QUAL-W2 User Manual.

DIFFERENCES BETWEEN VERSION 3.6 AND VERSION 3.5

Version 3.6 can be run without changing any of the input files, even though the preprocessor will identify errors in the control file because of missing variables. Below is a highlighted list of locations in the file w2_con.npt where additional variables have been added. There are no other changes in the input files for Version 3.6.

The TKE algorithm has been updated with new algorithms that match experimental tank data for kinetic energy and dissipation. This is based on a Master's degree project by Sam Gould at Portland State University. A new user option is the TKE1 algorithm, in add addition to the legacy algorithm TKE. This results in several new input variables on the following line of the w2_con.npt file that are only active if TKE1 is chosen for AZC:

```
EDDY VISC     AZC    AZSLC    AZMAX      FBC        E    ARODI STRCKLR BOUNDFR  TKECAL
WB 1           W2      IMP 1.00000        3    9.535    0.430    24.0   10.00     IMP
```

The roughness height of the water for correction of the vertical velocity wind profile is now a user-defined input, z_0. Prior to this the model had hardwired the value of z_0=0.003 m for wind speed correction at 2m (for evaporation where wind height at 2 m is typical) and z_0=0.01 m for wind at 10 m (for shear stress calculations where wind height of 10 m is typical). For consistency, both conversions now use the same value of roughness height. If the user does not specify the value of z_0 (for example if he/she leaves the spaces blank for z_0 using a V3.5 control file), the code uses 0.001 m.

```
HYD COEF       AX       DX     CBHE     TSED       FI    TSEDF    FRICC       Z0
WB 1      1.00000 1.00000 0.30000 11.5000 0.01000 1.00000     MANN    0.001
```

A new option for output is in the format required for TECPLOT. For TECPLOT animation there is only a flag in the CPL output line. This allows for easy model animation of the variables U, W, T, RHO, and all active constituents at the frequency specified by the CPL file as a function of distance and elevation.

```
CPL PLOT     CPLC     NCPL TECPLOT
WB 1           ON        1      ON
```

A new variable for determining the fraction of NO3-N that is diffused into the sediments that becomes organic matter, or SED-N was introduced. According to one study, only about 37% of NO_3-N that diffuses into the sediments becomes incorporated into organic matter in the sediments. The rest is denitrified.

```
   NITRATE     NO3DK     NO3S FNO3SED
   Wb 1         0.05      0.0     0.37
   Wb 2         0.05      0.0     0.37
```

In V3.5 the model computed an average decay coefficient of the sediments based on what was deposited. The user now has the option to dynamically compute that decay rate or to have it fixed and controlled by the model user. A new variable was introduced called DYNSEDK which is either ON/OFF to allow or not allow dynamic computation of the sediment decay rate.

```
   SEDIMENT     SEDC    PRNSC    SEDCI     SEDK     SEDS     FSOD     FSED    SEDBR DYNSEDK
   Wb 1           ON       ON      0.0      0.1      0.0      1.0      1.0    0.001      OFF
   Wb 2           ON       ON      0.0      0.1      0.0      1.0      1.0    0.001      OFF
```

The User can now specify the # of processors to use on the host computer. Most users find that setting NPROC=2 gets the best results. Sometimes setting this greater than 2 results in slower model performance. Also, the CLOSEC control closes the windows dialog box after the model completes its simulation. This is useful in using the windows version of the release code in batch simulations. These are specified in the control file as follows:

```
GRID          NWB      NBR      IMX      KMX    NPROC   CLOSEC
                1        4       66      117        2       ON
```

DIFFERENCES BETWEEN VERSION 3.2 AND VERSION 3.5

The differences in V3.5 and V3.2 input files are found in the control file: **w2_con.npt** and in the **graph.npt** file. All other files are the same between the 2 versions.

w2_con.npt

Below is an example of parts of the control file from V3.5 where all new variables are highlighted. Most of these changes have to do with the new zooplankton, macrophyte, and new state variables added to the model. See the User Manual for a list of changes between V3.2 and V 3.5 in the version history. Also there were some deletions from the V3.2 w2_con.npt file. These are shown below.

New variables added to the control file are highlighted

```
.
.
IN/OUTFL      NTR      NST      NIW      NWD      NGT      NSP      NPI      NPU
                1        1        0        0        0        0        0        0

CONSTITU      NGC      NSS      NAL      NEP     NBOD      NMC      NZP
                5        1        1        1        5        0        1

MISCELL      NDAY
               100
.
.
CST COMP      CCC     LIMC      CUF
               ON       ON       10

CST ACTIVE    CAC
TDS           OFF
Gen1           ON
Gen2          OFF
Gen3          OFF
Gen4          OFF
Gen5          OFF
ISS1          OFF
PO4           OFF
NH4           OFF
NO3           OFF
DSI           OFF
PSI           OFF
FE            OFF
LDOM          OFF
RDOM          OFF
LPOM          OFF
RPOM          OFF
BOD1          OFF
BOD2          OFF
BOD3          OFF
BOD4          OFF
BOD5          OFF
ALG1          OFF
```

```
DO            OFF
TIC           OFF
ALK           OFF
ZOO1          OFF
LDOM_P        OFF
RDOM_P        OFF
LPOM_P        OFF
RPOM_P        OFF
LDOM_N        OFF
RDOM_N        OFF
LPOM_N        OFF
RPOM_N        OFF

CST DERI    CDWBC    CDWBC    CDWBC    CDWBC    CDWBC    CDWBC    CDWBC    CDWBC    CDWBC
DOC           OFF
POC           OFF
TOC           OFF
DON           OFF
PON           OFF
TON           OFF
TKN           OFF
TN            OFF
DOP           OFF
POP           OFF
TOP           OFF
TP            OFF
APR           OFF
CHLA          OFF
ATOT          OFF
%DO           OFF
TSS           OFF
TISS          OFF
CBOD          OFF
pH            OFF
CO2           OFF
HCO3          OFF
CO3           OFF

CST FLUX    CFWBC    CFWBC    CFWBC    CFWBC    CFWBC    CFWBC    CFWBC    CFWBC    CFWBC
TISSIN        OFF
TISSOUT       OFF
PO4AR         OFF
PO4AG         OFF
PO4AP         OFF
PO4ER         OFF
PO4EG         OFF
PO4EP         OFF
PO4POM        OFF
PO4DOM        OFF
PO4OM         OFF
PO4SED        OFF
PO4SOD        OFF
PO4SET        OFF
NH4NITR       OFF
NH4AR         OFF
NH4AG         OFF
NH4AP         OFF
NH4ER         OFF
NH4EG         OFF
NH4EP         OFF
NH4POM        OFF
NH4DOM        OFF
NH4OM         OFF
```

```
NH4SED       OFF
NH4SOD       OFF
NO3DEN       OFF
NO3AG        OFF
NO3EG        OFF
NO3SED       OFF
DSIAG        OFF
DSIEG        OFF
DSIPIS       OFF
DSISED       OFF
DSISOD       OFF
DSISET       OFF
PSIAM        OFF
PSINET       OFF
PSIDK        OFF
FESET        OFF
FESED        OFF
LDOMDK       OFF
LRDOM        OFF
RDOMDK       OFF
LDOMAP       OFF
LDOMEP       OFF
LPOMDK       OFF
LRPOM        OFF
RPOMDK       OFF
LPOMAP       OFF
LPOMEP       OFF
LPOMSET      OFF
RPOMSET      OFF
CBODDK       OFF
DOAP         OFF
DOAR         OFF
DOEP         OFF
DOER         OFF
DOPOM        OFF
DODOM        OFF
DOOM         OFF
DONITR       OFF
DOCBOD       OFF
DOREAR       OFF
DOSED        OFF
DOSOD        OFF
TICAG        OFF
TICEG        OFF
SEDDK        OFF
SEDAS        OFF
SEDLPOM      OFF
SEDSET       OFF
SODDK        OFF

CST ICON   C2IWB   C2IWB   C2IWB   C2IWB   C2IWB   C2IWB   C2IWB   C2IWB   C2IWB
TDS      0.00000
Gen1     0.00000
Gen2     0.00000
Gen3     0.00000
Gen4     0.00000
Gen5     0.00000
ISS1     0.00000
PO4      0.03000
NH4      0.01000
NO3      0.30000
DSI      0.00000
PSI      0.00000
```

```
FE        0.00000
LDOM      0.10000
RDOM      0.10000
LPOM      0.10000
RPOM      0.10000
BOD1      0.00000
BOD2      0.00000
BOD3      0.00000
BOD4      0.00000
BOD5      0.00000
ALG1      0.10000
DO        12.0000
TIC       5.00000
ALK       19.8000
ZOO1       0.1000
LDOM_P     0.0005
RDOM_P     0.0005
LPOM_P     0.0005
RPOM_P     0.0005
LDOM_N     0.0080
RDOM_N     0.0080
LPOM_N     0.0080
RPOM_N     0.0080

CST PRIN  CPRWBC  CPRWBC  CPRWBC  CPRWBC  CPRWBC  CPRWBC  CPRWBC  CPRWBC  CPRWBC
TDS           OFF
Gen1           ON
Gen2          OFF
Gen3          OFF
Gen4          OFF
Gen5          OFF
ISS1          OFF
PO4           OFF
NH4           OFF
NO3           OFF
DSI           OFF
PSI           OFF
FE            OFF
LDOM          OFF
RDOM          OFF
LPOM          OFF
RPOM          OFF
BOD1          OFF
BOD2          OFF
BOD3          OFF
BOD4          OFF
BOD5          OFF
ALG1          OFF
DO            OFF
TIC           OFF
ALK           OFF
ZOO1          OFF
LDOM_P        OFF
RDOM_P        OFF
LPOM_P        OFF
RPOM_P        OFF
LDOM_N        OFF
RDOM_N        OFF
LPOM_N        OFF
RPOM_N        OFF

CIN CON   CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC
TDS            ON
```

```
Gen1          OFF
Gen2           ON
Gen3           ON
Gen4           ON
Gen5           ON
ISS1           ON
PO4            ON
NH4            ON
NO3            ON
DSI           OFF
PSI           OFF
FE            OFF
LDOM           ON
RDOM           ON
LPOM           ON
RPOM           ON
BOD1           ON
BOD2           ON
BOD3           ON
BOD4           ON
BOD5           ON
ALG1           ON
DO             ON
TIC            ON
ALK            ON
ZOO1          OFF
LDOM_P        OFF
RDOM_P        OFF
LPOM_P        OFF
RPOM_P        OFF
LDOM_N        OFF
RDOM_N        OFF
LPOM_N        OFF
RPOM_N        OFF

CTR CON   CTRTRC  CTRTRC  CTRTRC  CTRTRC  CTRTRC  CTRTRC  CTRTRC  CTRTRC  CTRTRC
TDS            ON       ON
Gen1          OFF      OFF
Gen2           ON       ON
Gen3           ON       ON
Gen4           ON       ON
Gen5           ON       ON
ISS1           ON       ON
PO4            ON       ON
NH4            ON       ON
NO3            ON       ON
DSI           OFF      OFF
PSI           OFF      OFF
FE            OFF      OFF
LDOM           ON       ON
RDOM           ON       ON
LPOM           ON       ON
RPOM           ON       ON
BOD1           ON       ON
BOD2           ON       ON
BOD3           ON       ON
BOD4           ON       ON
BOD5           ON       ON
ALG1           ON       ON
DO             ON       ON
TIC            ON       ON
ALK            ON       ON
ZOO1          OFF      OFF
```

```
LDOM_P          OFF      OFF
RDOM_P          OFF      OFF
LPOM_P          OFF      OFF
RPOM_P          OFF      OFF
LDOM_N          OFF      OFF
RDOM_N          OFF      OFF
LPOM_N          OFF      OFF
RPOM_N          OFF      OFF

CDT CON    CDTBRC  CDTBRC  CDTBRC  CDTBRC  CDTBRC  CDTBRC  CDTBRC  CDTBRC  CDTBRC
TDS             ON
Gen1           OFF
Gen2            ON
Gen3            ON
Gen4            ON
Gen5            ON
ISS1            ON
PO4             ON
NH4             ON
NO3             ON
DSI            OFF
PSI            OFF
FE             OFF
LDOM            ON
RDOM            ON
LPOM            ON
RPOM            ON
BOD1            ON
BOD2            ON
BOD3            ON
BOD4            ON
BOD5            ON
ALG1            ON
DO              ON
TIC             ON
ALK             ON
ZOO1           OFF
LDOM_P         OFF
RDOM_P         OFF
LPOM_P         OFF
RPOM_P         OFF
LDOM_N         OFF
RDOM_N         OFF
LPOM_N         OFF
RPOM_N         OFF

CPR CON    CPRBRC  CPRBRC  CPRBRC  CPRBRC  CPRBRC  CPRBRC  CPRBRC  CPRBRC  CPRBRC
TDS             ON
Gen1           OFF
Gen2            ON
Gen3            ON
Gen4            ON
Gen5            ON
ISS1            ON
PO4             ON
NH4             ON
NO3             ON
DSI            OFF
PSI            OFF
FE             OFF
LDOM            ON
RDOM            ON
LPOM            ON
```

```
RPOM            ON
BOD1            ON
BOD2            ON
BOD3            ON
BOD4            ON
BOD5            ON
ALG1            ON
DO              ON
TIC             ON
ALK             ON
ZOO1           OFF
LDOM_P         OFF
RDOM_P         OFF
LPOM_P         OFF
RPOM_P         OFF
LDOM_N         OFF
RDOM_N         OFF
LPOM_N         OFF
RPOM_N         OFF

EX COEF     EXH2O     EXSS     EXOM     BETA      EXC     EXIC
WB 1      0.45000  0.01000  0.40000  0.45000      OFF      OFF

ALG EX        EXA      EXA      EXA      EXA      EXA      EXA
          0.10000

ZOO EX        EXZ      EXZ      EXZ      EXZ      EXZ      EXZ
              0.2      0.2      0.2

MACRO EX      EXM      EXM      EXM      EXM      EXM      EXM
           0.0100

GENERIC     CGQ10    CG0DK    CG1DK      CGS
CG 1      0.00000 -1.0000  0.00000  0.00000
CG 2      0.00000  0.00000  0.00000  0.00000
CG 3      1.04000  0.00000  0.50000  0.00000
CG 4      0.00000  0.00000  0.00000  0.00000
CG 5      0.00000  0.00000  0.00000  0.00000

S SOLIDS      SSS    SEDRC    TAUCR
SS1       1.50000      OFF     0.00

ALGAL RATE     AG       AR       AE       AM       AS     AHSP     AHSN    AHSSI     ASAT
ALG1      2.00000  0.12000  0.02000  0.05000  0.04000  0.00500  0.00500  0.00000  50.0000

ALGAL TEMP    AT1      AT2      AT3      AT4      AK1      AK2      AK3      AK4
ALG1      5.00000  12.0000  20.0000  30.0000  0.10000  0.99000  0.99000  0.10000

ALG STOI     ALGP     ALGN     ALGC    ALGSI    ACHLA    ALPOM    ANEQN     ANPR
ALG1      0.00500  0.08000  0.45000  0.00000  65.0000  0.80000        1  0.00100

EPIPHYTE     EPIC     EPIC     EPIC     EPIC     EPIC     EPIC     EPIC     EPIC     EPIC
EPI1          OFF

EPI PRIN     EPRC     EPRC     EPRC     EPRC     EPRC     EPRC     EPRC     EPRC     EPRC
EPI1          OFF

EPI INIT    EPICI    EPICI    EPICI    EPICI    EPICI    EPICI    EPICI    EPICI    EPICI
EPI1      10.0000

EPI RATE       EG       ER       EE       EM       EB     EHSP     EHSN    EHSSI
EPI1      2.00000  0.05000  0.02000  0.05000  0.01000  0.00200  0.00200  0.00000
```

```
EPI HALF     ESAT      EHS    ENEQN     ENPR
EPI1      50.0000 40.0000        2 0.00200

EPI TEMP      ET1      ET2      ET3      ET4      EK1      EK2      EK3      EK4
EPI1      2.00000 5.00000 20.0000 30.0000 0.10000 0.99000 0.99000 0.10000

EPI STOI       EP       EN       EC      ESI    ECHLA     EPOM
EPI1      0.00500 0.08000 0.45000 0.00000 65.0000 0.80000

ZOOP RATE      ZG       ZR       ZM     ZEFF    PREFP  ZOOMIN     ZS2P
Zoo1         1.50     0.10    0.010     0.50     0.50  0.0100     0.30

ZOOP ALGP  PREFA    PREFA    PREFA    PREFA    PREFA    PREFA    PREFA    PREFA    PREFA
Zoo1         1.00     0.50     0.50

ZOOP ZOOP  PREFZ    PREFZ    PREFZ    PREFZ    PREFZ    PREFZ    PREFZ    PREFZ    PREFZ
Zoo1         0.00     0.00     0.00

ZOOP TEMP     ZT1      ZT2      ZT3      ZT4      ZK1      ZK2      ZK3      ZK4
              0.0     15.0     20.0     36.0      0.1      0.9     0.98    0.100

ZOOP STOI      ZP       ZN       ZC
         0.01500 0.08000 0.45000

MACROPHYT MACWBC  MACWBC   MACWBC   MACWBC   MACWBC   MACWBC   MACWBC   MACWBC   MACWBC
Mac1         ON      OFF      OFF

MAC PRINT MPRWBC  MPRWBC   MPRWBC   MPRWBC   MPRWBC   MPRWBC   MPRWBC   MPRWBC   MPRWBC
Mac1         ON      OFF      OFF

MAC INI  MACWBCI MACWBCI MACWBCI MACWBCI MACWBCI MACWBCI MACWBCI MACWBCI MACWBCI
Mac1      0.00000      0.1      0.5

MAC RATE       MG       MR       MM     MSAT     MHSP     MHSN     MHSC     MPOM   LRPMAC
Mac 1        0.30     0.05     0.05     30.0      0.0      0.0      0.0      0.9      0.2

MAC SED      PSED     NSED
MAC 1         0.5      0.5

MAC DIST     MBMP     MMAX
Mac 1        40.0    500.0

MAC DRAG   CDSTEM      DWV     DMSA    ANORM
Mac 1         2.0      7e4     8.00     0.80

MAC TEMP      MT1      MT2      MT3      MT4      MK1      MK2      MK3      MK4
Mac 1         7.0     15.0     24.0     34.0      0.1     0.99     0.99     0.01

MAC STOICH     MP       MN       MC
Mac 1       0.005     0.08     0.45

DOM        LDOMDK   RDOMDK   LRDDK
WB 1      0.10000 0.00100 0.00100

POM        LPOMDK   RPOMDK   LRPDK     POMS
WB 1      0.08000 0.00100 0.00100 0.10000

OM STOIC     ORGP     ORGN     ORGC    ORGSI
WB 1      0.00500 0.08000 0.45000 0.18000

OM RATE      OMT1     OMT2     OMK1     OMK2
WB 1      4.00000 30.0000 0.10000 0.99000
```

```
CBOD         KBOD    TBOD    RBOD    CBODS
BOD 1     0.04180 1.01470 1.00000      0.0
BOD 2     0.13020 1.01470 1.00000      0.0
BOD 3     0.04690 1.01470 1.00000      0.0
BOD 4     0.08800 1.01470 1.00000      0.0
BOD 5     0.05000 1.01470 1.00000      0.0

CBOD STOIC  BODP    BODN    BODC
BOD 1     0.00500 0.08000 0.45000
BOD 2     0.00500 0.08000 0.45000
BOD 3     0.00500 0.08000 0.45000
BOD 4     0.00500 0.08000 0.45000
BOD 5     0.00500 0.08000 0.45000

PHOSPHOR    PO4R   PARTP
WB 1      0.00100 0.00000

AMMONIUM    NH4R   NH4DK
WB 1      0.00100 0.50000

NH4 RATE   NH4T1   NH4T2   NH4K1   NH4K2
WB 1      5.00000 25.0000 0.10000 0.99000

NITRATE    NO3DK    NO3S
WB 1      0.05000 0.00000

NO3 RATE   NO3T1   NO3T2   NO3K1   NO3K2
WB 1      5.00000 25.0000 0.10000 0.99000

SILICA      DSIR    PSIS   PSIDK  PARTSI
WB 1      0.10000 0.00000 0.30000 0.20000

IRON         FER     FES
WB 1      0.10000 0.00000

SED CO2     CO2R
WB 1      0.10000

STOICH 1   O2NH4    O2OM
WB 1      4.57000 1.40000

STOICH 2    O2AR    O2AG
ALG1      1.10000 1.40000

STOICH 3    O2ER    O2EG
EPI1      1.10000 1.40000

STOICH 4    O2ZR
ZOO1      1.10000

STOICH 5    O2MR    O2MG
MAC1           1.1     1.4

O2 LIMIT     KDO
          0.10000

SEDIMENT    SEDC  SEDPRC   SEDCI    SEDK    SEDS    FSOD    FSED   SEDBR
WB 1          ON      ON 0.00000 0.10000     0.1 1.00000 1.00000     0.2

SOD RATE   SODT1   SODT2   SODK1   SODK2
WB 1      4.00000 30.0000 0.10000 0.99000

S DEMAND     SOD     SOD     SOD     SOD     SOD     SOD     SOD     SOD     SOD
```

```
              0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6
              0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6
              0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6
              0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6
              0.6

REAERATION  TYPE    EQN#    COEF1   COEF2   COEF3   COEF4
WB1         LAKE       6
```

Lines removed from the V3.2 control file: These are a result of eliminating the pumpback and line printer settings.

Here is the part of the V3.2 control file that was deleted:

```
DST TRIB    DTRC
Br 1          ON
Br 2          ON
Br 3         OFF
Br 4         OFF
Br 5         OFF

PUMPBACK      JBG      KTG      KBG      JBP      KTP      KBP
              0

PRINTER       LJC
              IV

HYD PRINT HPRWBC  HPRWBC  HPRWBC  HPRWBC  HPRWBC  HPRWBC  HPRWBC  HPRWBC  HPRWBC
NVIOL        OFF     OFF
U             ON      ON
```

Graph.npt file changes. These changes are a result of the new state variables in W2 and are highlighted below.

```
Hydrodynamic, constituent, and derived constituent names, formats, multipliers, and array viewer
controls

.....................HNAME.....................     FMTH    HMULT     HMIN     HMAX   HPLTC       #
Timestep violations [NVIOL]                         (I10)      1.0     -1.0      1.0     OFF       1
Horizontal velocity [U], m/s                    (1PE10.1)      1.0  -.1000     0.15     OFF       2
Vertical velocity [W], m/s                      (1PE10.1)      1.0  -.1E-6   -0.01      OFF       3
Temperature [T1], <o/>C                           (F10.2)      1.0   -10.0   -26.0       ON       4
Density [RHO], g/m^3                              (F10.3)      1.0   997.0  1005.0     OFF       5
Vertical eddy viscosity [AZ], m^2/s               (F10.3)      1.0  -1E-08    0.01     OFF       6
Velocity shear stress [SHEAR], 1/s^2              (F10.3)      1.0  -1E-08    0.01     OFF       7
Internal shear [ST], m^3/s                        (F10.3)      1.0  -1E-08    0.01     OFF       8
Bottom shear [SB], m^3/s                          (F10.3)      1.0  -1E-08    0.01     OFF       9
Longitudinal momentum [ADMX], m^3/s               (F10.3)      1.0  -1E-08    0.01     OFF      10
Longitudinal momentum [DM], m^3/s                 (F10.3)      1.0  -1E-08    0.01     OFF      11
Horizontal density gradient [HDG], m^3/s          (F10.3)      1.0  -1E-08    0.01     OFF      12
Vertical momentum [ADMZ], m^3/s                   (F10.3)      1.0  -1E-08    0.01     OFF      13
Horizontal pressure gradient [HPG], m^3/s         (F10.3)      1.0  -1E-08    10.0     OFF      14
Gravity term channel slope [GRAV], m^3/s          (F10.3)      1.0     0.0     0.0     OFF      15

.....................CNAME.....................     FMTC    CMULT     CMIN     CMAX   CPLTC       #
TDS, g/m^3                                        (F10.3)      1.0     -1.0   200.0     OFF       1
Age, days                                         (F10.3)      1.0     -1.0  -200.0      ON       2
Tracer, g/m^3                                     (F10.3)      1.0 -20.000   100.0     OFF       3
Bacteria, col/100ml                               (F10.3)      1.0 -20.000   100.0     OFF       4
Conductivity, mhos                                (F10.3)      1.0 -20.000   100.0     OFF       5
```

Chloride, mg/l	(F10.3)	1.0	-20.000	100.0	OFF	6
ISS, g/m^3	(F10.3)	1.0	-20.000	100.0	OFF	7
Phosphate, g/m^3	(F10.3)	1000.0	-1.0	500.0	OFF	8
Ammonium, g/m^3	(F10.3)	1000.0	-0.1000	300.0	OFF	9
Nitrate-Nitrite, g/m^3	(F10.3)	1.0	-0.1000	5.0	OFF	10
Dissolved silica, g/m^3	(F10.3)	1.0	-1.0	10.0	OFF	11
Particulate silica, g/m^3	(F10.3)	1.0	-0.2000	15.0	OFF	12
Total iron, g/m^3	(F10.3)	1.0	-0.1000	2.0	OFF	13
Labile DOM, g/m^3	(F10.3)	1.0	-0.1000	-3.0	OFF	14
Refractory DOM, g/m^3	(F10.3)	1.0	-0.1000	-4.0	OFF	15
Labile POM, g/m^3	(F10.3)	1.0	-0.1000	-3.0	OFF	16
Refractory POM, g/m^3	(F10.3)	1.0	-0.1000	-4.0	OFF	17
CBOD1, g/m^3	(F10.3)	1.0	-0.0100	3.0	OFF	18
CBOD2, g/m^3	(F10.3)	1.0	-0.0100	3.0	OFF	19
CBOD3, g/m^3	(F10.3)	1.0	-0.0100	3.0	OFF	20
CBOD4, g/m^3	(F10.3)	1.0	-0.0100	3.0	OFF	21
CBOD5, g/m^3	(F10.3)	1.0	-0.0100	3.0	OFF	22
Algae, g/m^3	(F10.3)	1.0	-0.0100	3.0	OFF	23
Dissolved oxygen, g/m^3	(F10.3)	1.0	-0.0100	-1.0	OFF	24
Inorganic carbon, g/m^3	(F10.3)	1.0	-0.0100	3.0	OFF	25
Alkalinity, g/m^3	(F10.3)	1.0	-0.0100	3.0	OFF	26
zooplankton1, mg/m^3	(g10.3)	1000.0	-0.0100	1.0	OFF	27
LDOM P, mg/m^3	(g10.3)	1000.0	0.0	1.0	OFF	28
RDOM P, mg/m^3	(g10.3)	1000.0	0.0	1.0	OFF	29
LPOM P, mg/m^3	(g10.3)	1000.0	0.0	1.0	OFF	30
RPOM P, mg/m^3	(g10.3)	1000.0	0.0	1.0	OFF	31
LDOM N, mg/m^3	(g10.3)	1000.0	0.0	1.0	OFF	32
RDOM N, mg/m^3	(g10.3)	1000.0	0.0	1.0	OFF	33
LPOM N, mg/m^3	(g10.3)	1000.0	0.0	1.0	OFF	34
RPOM N, mg/m^3	(g10.3)	1000.0	0.0	1.0	OFF	35

.....CDNAME.....	FMTCD	CDMULT	CDMIN	CDMAX	CDPLTC	#
Dissolved organic carbon, g/m^3	(F10.3)	1.0	-1.0	25.0	OFF	1
Particulate organic carbon, g/m^3	(F10.3)	1.0	-1.0	50.0	OFF	2
Total organic carbon, g/m^3	(F10.3)	1.0	-1.0	25.0	OFF	3
Dissolved organic nitrogen, g/m^3	(F10.3)	1.0	-1.0	25.0	OFF	4
Particulate organic nitrogen, g/m^3	(F10.3)	1.0	-1.0	25.0	OFF	5
Total organic nitrogen, g/m^3	(F10.3)	1.0	-1.0	50.0	OFF	6
Total Kheldahl Nitrogen, g/m^3	(F10.3)	1.0	-1.0	15.0	OFF	7
Total nitrogen, g/m^3	(F10.3)	1.0	-1.0	15.0	OFF	8
Dissolved organic phosphorus, mg/m^3	(F10.3)	1000.0	-1.0	25.0	OFF	9
Particulate organic phosphorus, mg/m^3	(F10.3)	1000.0	-1.0	-1.0	OFF	10
Total organic phosphorus, mg/m^3	(F10.3)	1000.0	-1.0	5.0	OFF	11
Total phosphorus, mg/m^3	(F10.3)	1000.0	-1.0	20.0	OFF	12
Algal production, g/m^2/day	(F10.3)	1.0	-1.0	5.0	OFF	13
Chlorophyll a, mg/m^3	(F10.3)	1.0	-5.0	145.0	OFF	14
Total algae, g/m^3	(F10.3)	1.0	-1.0	60.0	OFF	15
Oxygen % Gas Saturation	(F10.3)	1.0	-1.0	50.0	OFF	16
Total suspended Solids, g/m^3	(F10.3)	1.0	-1.0	5.0	OFF	17
Total Inorganic Suspended Solids,g/m^3	(F10.3)	1.0	-1.0	20.0	OFF	18
Carbonaceous Ultimate BOD, g/m^3	(F10.3)	1.0	5.0	9.0	OFF	19
pH	(F10.3)	1.0	-1.0	10.0	OFF	20
CO2	(F10.3)	1.0	-1.0	10.0	OFF	21
HCO3	(F10.3)	1.0	-1.0	10.0	OFF	22
CO3	(F10.3)	0.0	0.0	0.0	OFF	23

DIFFERENCES BETWEEN VERSION 3.1 AND VERSION 3.2

There are minor differences in 2 input files between the 2 versions: **w2_con.npt** and the **graph.npt** file. All other files are the same between the 2 versions.

w2_con.npt

The only section where there is a slight difference in the control file is in the section where the inorganic suspended solids group settling velocities are entered. In Version 3.1, this section looks like this:

```
ALG EX       EXA     EXA     EXA     EXA     EXA     EXA
         0.10000

GENERIC    CGQ10   CG0DK   CG1DK     CGS
CG 1     0.00000 -1.0000 0.00000 0.00000
CG 2     0.00000 0.00000 0.00000 0.00000
CG 3     1.04000 0.00000 0.50000 0.00000
CG 4     0.00000 0.00000 0.00000 0.00000
CG 5     0.00000 0.00000 0.00000 0.00000

S SOLIDS     SSS     SSS     SSS     SSS     SSS     SSS     SSS     SSS     SSS
         1.50000

ALGAL RATE    AG      AR      AE      AM      AS    AHSP    AHSN   AHSSI    ASAT
ALG1     2.00000 0.12000 0.02000 0.05000 0.04000 0.00500 0.00500 0.00000 50.0000
```

In Version 3.2, there is now a sediment resuspension capability for wind driven resuspension along the shores of lakes and reservoirs. The Version 3.2 control file has the following lines in this same section of the control file:

```
ALG EX       EXA     EXA     EXA     EXA     EXA     EXA
         0.10000

GENERIC    CGQ10   CG0DK   CG1DK     CGS
CG 1     0.00000 -1.0000 0.00000 0.00000
CG 2     0.00000 0.00000 0.00000 0.00000
CG 3     1.04000 0.00000 0.50000 0.00000
CG 4     0.00000 0.00000 0.00000 0.00000
CG 5     0.00000 0.00000 0.00000 0.00000

S SOLIDS     SSS   SEDRC   TAUCR
SS1      1.50000     OFF    0.00

ALGAL RATE    AG      AR      AE      AM      AS    AHSP    AHSN   AHSSI    ASAT
ALG1     2.00000 0.12000 0.02000 0.05000 0.04000 0.00500 0.00500 0.00000 50.0000
```

For Version 3.2, SSS is the settling velocity for particle group 1, SEDRC is the control which turns ON or OFF sediment resuspension, and TAUCR is the critical shear stress at which resuspension occurs. For Version 3.2, each line represents 1 SS group, while in Version 3.1, each group settling velocity is in the next 8 columns moving across the page.

graph.npt

The graph file controls output formatting and the graphing parameters used in Array Viewer (only for the PC platform). The files have been rearranged significantly. A Version 3.1 graph file is shown below:

```
Constituent, hydrodynamic, and derived constituent names, formats, multipliers, and array viewer
controls

.....................CNAME.....................   CMULT    CMIN    CMAX   CPLTC       #
TDS g/m^3 or Salinity kg/m^3                    1.00000 -1.0000 200.000     OFF       1
Generic Constituent,g/m^3, #1                   1.00000 -1.0000 -200.00      ON       2
Generic Constituent,g/m^3, #2                   1.00000 -1.0000 1000.00     OFF       3
Generic Constituent,g/m^3, #3                   1.00000 -1.0000 5.00000     OFF       4
Generic Constituent,g/m^3, #4                   1.00000 -1.0000 -300.00     OFF       5
Generic Constituent,g/m^3, #5                   1.00000 -1.0000 -3.0000     OFF       6
Suspended solids,g/m^3, #1                      1.00000 -1.0000 15.0000     OFF       7
Phosphate, g/m^3                                1000.00 -1.0000 -50.000     OFF       8
Ammonium,  g/m^3                                1000.00 -0.1000 -300.00     OFF       9
Nitrate-Nitrite, g/m^3                          1.00000 -0.1000 -5.0000     OFF      10
Dissolved silica, g/m^3                         1.00000 -1.0000 10.0000     OFF      11
Particulate silica, g/m^3                       1.00000 -0.2000 15.0000     OFF      12
Total iron, g/m^3                               1.00000 -0.1000 2.00000     OFF      13
Labile DOM, g/m^3                               1.00000 -0.1000 -3.0000     OFF      14
Refractory DOM, g/m^3                           1.00000 -0.1000 4.00000     OFF      15
Labile POM, g/m^3                               1.00000 -0.1000 3.00000     OFF      16
Refractory POM, g/m^3                           1.00000 -0.1000 4.00000     OFF      17
CBOD, g/m^3,     #1                             1.00000 -0.1000 10.0000     OFF      18
CBOD, g/m^3,     #2                             1.00000 -0.1000 10.0000     OFF      19
CBOD, g/m^3,     #3                             1.00000 -0.1000 10.0000     OFF      20
CBOD, g/m^3,     #4                             1.00000 -0.1000 10.0000     OFF      21
CBOD, g/m^3,     #5                             1.00000 -0.1000 10.0000     OFF      22
Algae,  g/m^3,      #1                          1.00000 -0.0100 -3.0000     OFF      23
Dissolved oxygen, g/m^3                         1.00000 -2.0000 15.0000     OFF      24
Inorganic carbon, g/m^3                         1.00000 -1.0000 10.0000     OFF      25
Alkalinity, g/m^3                               1.00000 -1.0000 200.000     OFF      26

.....................HNAME.....................     HFMT    HMIN    HMAX   HPLTC       #
Timestep violations [NVIOL]                     (F10.0) -1.0000  100000     OFF       1
Horizontal velocity [U], m/s                  (1PE10.1) -0.0100 0.10000      ON       2
Vertical velocity [W], m/s                    (1PE10.1)-.10E-06 0.01000     OFF       3
Temperature [T1], <o/>C                         (F10.2) -2.0000 -30.000      ON       4
Density [RHO], g/m^3                            (F10.2) 997.000 1005.00     OFF       5
Vertical eddy viscosity [AZ], m^2/s           (1PE10.1)  -1E-08 0.00100     OFF       6
Velocity shear stress [SHEAR], 1/s^2          (1PE10.1)  -1E-08 0.01000     OFF       7
Internal shear [ST], m^3/s                    (1PE10.1)  -1E-08 0.01000     OFF       8
Bottom shear [SB], m^3/s                      (1PE10.1)  -1E-08 0.01000     OFF       9
Longitudinal momentum [ADMX], m^3/s           (1PE10.1)  -1E-08 0.01000     OFF      10
Longitudinal momentum [DM], m^3/s             (1PE10.1)  -1E-08 0.01000     OFF      11
Horizontal density gradient [HDG], m^3/s      (1PE10.1)  -1E-08 0.01000     OFF      12
Vertical momentum [ADMZ], m^3/s               (1PE10.1)  -1E-08 0.01000     OFF      13
Horizontal pressure gradient [HPG], m^3/s     (1PE10.1)  -1E-08 0.01000     OFF      14
Gravity term channel slope [GRAV], m^3/s      (1PE10.1)  -1E-08 10.0000     OFF      15

.....................CDNAME.....................  CDMULT   CDMIN   CDMAX  CDPLTC       #
Dissolved organic carbon, g/m^3                 1.00000 -1.0000 3.00000     OFF       1
Particulate organic carbon, g/m^3               1.00000 -1.0000 25.0000     OFF       2
Total organic carbon, g/m^3                     1.00000 -1.0000 50.0000     OFF       3
Dissolved organic nitrogen, g/m^3               1.00000 -1.0000 25.0000     OFF       4
Particulate organic nitrogen, g/m^3             1.00000 -1.0000 25.0000     OFF       5
Total organic nitrogen, g/m^3                   1.00000 -1.0000 25.0000     OFF       6
Total Kheldahl Nitrogen, g/m^3                  1.00000 -1.0000 5.00000     OFF       7
```

```
Total nitrogen, g/m^3                          1.00000 -1.0000 50.0000     OFF       8
Dissolved organic phosphorus, mg/m^3           1000.00 -1.0000 15.0000     OFF       9
Particulate organic phosphorus, mg/m^3         1000.00 -1.0000 15.0000     OFF      10
Total organic phosphorus, mg/m^3               1000.00 -1.0000 25.0000     OFF      11
Total phosphorus, mg/m^3                       1000.00 -1.0000 -1.0000     OFF      12
Algal production, g/m^2/day                    1.00000 -1.0000 5.00000     OFF      13
Chlorophyll a, mg/m^3                          1000.00 -1.0000 -70.000     OFF      14
Total algae, g/m^3                             1.00000 -1.0000 5.00000     OFF      15
Oxygen % Gas Saturation                        1.00000 -5.0000 145.000     OFF      16
Total suspended Solids, g/m^3                  1.00000 -1.0000 60.0000     OFF      17
Total Inorganic Suspended Solids,g/m^3         1.00000 -1.0000 50.0000     OFF      18
Carbonaceous Ultimate BOD, g/m^3               1.00000 -1.0000 20.0000     OFF      19
pH                                             1.00000 6.00000 9.00000     OFF      20
CO2                                            1.00000 -1.0000 10.0000     OFF      21
HCO3                                           1.00000 -1.0000 10.0000     OFF      22
CO3                                            1.00000 -1.0000 10.0000     OFF      23
```

An example of the same graph file but for Version 3.2 is shown below:

```
Hydrodynamic, constituent, and derived constituent names, formats, multipliers, and array viewer
controls

.....................HNAME.....................     FMTH    HMULT     HMIN     HMAX   HPLTC       #
Timestep violations [NVIOL]                         (I10)      1.0     -1.0      1.0     OFF       1
Horizontal velocity [U], m/s                      (Z10.8)      1.0  -.1000     0.15      ON       2
Vertical velocity [W], m/s                        (Z10.8)      1.0  -.1E-6   -0.01     OFF       3
Temperature [T1], <o/>C                           (Z10.8)      1.0   -10.0   -26.0      ON       4
Density [RHO], g/m^3                              (Z10.8)      1.0   997.0  1005.0     OFF       5
Vertical eddy viscosity [AZ], m^2/s               (Z10.8)      1.0  -1E-08    0.01     OFF       6
Velocity shear stress [SHEAR], 1/s^2              (Z10.8)      1.0  -1E-08    0.01     OFF       7
Internal shear [ST], m^3/s                        (Z10.8)      1.0  -1E-08    0.01     OFF       8
Bottom shear [SB], m^3/s                          (Z10.8)      1.0  -1E-08    0.01     OFF       9
Longitudinal momentum [ADMX], m^3/s               (Z10.8)      1.0  -1E-08    0.01     OFF      10
Longitudinal momentum [DM], m^3/s                 (Z10.8)      1.0  -1E-08    0.01     OFF      11
Horizontal density gradient [HDG], m^3/s          (Z10.8)      1.0  -1E-08    0.01     OFF      12
Vertical momentum [ADMZ], m^3/s                   (Z10.8)      1.0  -1E-08    0.01     OFF      13
Horizontal pressure gradient [HPG], m^3/s         (Z10.8)      1.0  -1E-08    10.0     OFF      14
Gravity term channel slope [GRAV], m^3/s          (Z10.8)      1.0     0.0     0.0     OFF      15

.....................CNAME.....................     FMTC    CMULT     CMIN     CMAX   CPLTC       #
TDS, g/m^3                                        (Z10.8)      1.0     -1.0   200.0     OFF       1
Age, days                                         (Z10.8)      1.0     -1.0  -200.0      ON       2
Tracer, g/m^3                                     (Z10.8)      1.0 -20.000   100.0     OFF       3
Bacteria, col/100ml                               (Z10.8)      1.0 -20.000   100.0     OFF       4
Conductivity, mhos                                (Z10.8)      1.0 -20.000   100.0     OFF       5
Chloride, mg/l                                    (Z10.8)      1.0 -20.000   100.0     OFF       6
ISS, g/m^3                                        (Z10.8)      1.0 -20.000   100.0     OFF       7
Phosphate, g/m^3                                  (Z10.8)   1000.0    -1.0   500.0     OFF       8
Ammonium, g/m^3                                   (Z10.8)   1000.0 -0.1000   300.0     OFF       9
Nitrate-Nitrite, g/m^3                            (Z10.8)      1.0 -0.1000     5.0     OFF      10
Dissolved silica, g/m^3                           (Z10.8)      1.0     -1.0    10.0     OFF      11
Particulate silica, g/m^3                         (Z10.8)      1.0 -0.2000    15.0     OFF      12
Total iron, g/m^3                                 (Z10.8)      1.0 -0.1000     2.0     OFF      13
Labile DOM, g/m^3                                 (Z10.8)      1.0 -0.1000    -3.0     OFF      14
Refractory DOM, g/m^3                             (Z10.8)      1.0 -0.1000    -4.0     OFF      15
Labile POM, g/m^3                                 (Z10.8)      1.0 -0.1000    -3.0     OFF      16
Refractory POM, g/m^3                             (Z10.8)      1.0 -0.1000    -4.0     OFF      17
CBOD1, g/m^3                                      (Z10.8)      1.0 -0.0100     3.0     OFF      18
CBOD2, g/m^3                                      (Z10.8)      1.0 -0.0100     3.0     OFF      19
CBOD3, g/m^3                                      (Z10.8)      1.0 -0.0100     3.0     OFF      20
CBOD4, g/m^3                                      (Z10.8)      1.0 -0.0100     3.0     OFF      21
CBOD5, g/m^3                                      (Z10.8)      1.0 -0.0100     3.0     OFF      22
```

Algae, g/m^3	(Z10.8)	1.0	-0.0100	3.0	OFF	23
Dissolved oxygen, g/m^3	(Z10.8)	1.0	-0.0100	-1.0	OFF	24
Inorganic carbon, g/m^3	(Z10.8)	1.0	-0.0100	3.0	OFF	25
Alkalinity, g/m^3	(Z10.8)	1.0	-0.0100	3.0	OFF	26

.....CDNAME.....	FMTCD	CDMULT	CDMIN	CDMAX	CDPLTC	#
Dissolved organic carbon, g/m^3	(F10.3)	1.0	-1.0	25.0	OFF	1
Particulate organic carbon, g/m^3	(F10.3)	1.0	-1.0	50.0	OFF	2
Total organic carbon, g/m^3	(F10.3)	1.0	-1.0	25.0	OFF	3
Dissolved organic nitrogen, g/m^3	(F10.3)	1.0	-1.0	25.0	OFF	4
Particulate organic nitrogen, g/m^3	(F10.3)	1.0	-1.0	25.0	OFF	5
Total organic nitrogen, g/m^3	(F10.3)	1.0	-1.0	50.0	OFF	6
Total Kheldahl Nitrogen, g/m^3	(F10.3)	1.0	-1.0	15.0	OFF	7
Total nitrogen, g/m^3	(F10.3)	1.0	-1.0	15.0	OFF	8
Dissolved organic phosphorus, mg/m^3	(F10.3)	1000.0	-1.0	25.0	OFF	9
Particulate organic phosphorus, mg/m^3	(F10.3)	1000.0	-1.0	-1.0	OFF	10
Total organic phosphorus, mg/m^3	(F10.3)	1000.0	-1.0	5.0	OFF	11
Total phosphorus, mg/m^3	(F10.3)	1000.0	-1.0	20.0	OFF	12
Algal production, g/m^2/day	(F10.3)	1.0	-1.0	5.0	OFF	13
Chlorophyll a, mg/m^3	(F10.3)	1.0	-5.0	145.0	OFF	14
Total algae, g/m^3	(F10.3)	1.0	-1.0	60.0	OFF	15
Oxygen % Gas Saturation	(F10.3)	1.0	-1.0	50.0	OFF	16
Total suspended Solids, g/m^3	(F10.3)	1.0	-1.0	5.0	OFF	17
Total Inorganic Suspended Solids,g/m^3	(F10.3)	1.0	-1.0	20.0	OFF	18
Carbonaceous Ultimate BOD, g/m^3	(F10.3)	1.0	5.0	9.0	OFF	19
pH	(F10.3)	1.0	-1.0	10.0	OFF	20
CO2	(F10.3)	1.0	-1.0	10.0	OFF	21
HCO3	(F10.3)	1.0	-1.0	10.0	OFF	22
CO3	(F10.3)	0.0	0.0	0.0	OFF	23

In Version 3.2, the user has format control of all output variables, as well as MULT control (see User Manual). In Version 3.1, some groups had one but not the other. Also, in Version 3.2, the groups (HNAME, CNAME, CDNAME) were reordered.

BUG FIXES AND ENHANCEMENTS BETWEEN VERSIONS

There have been many updates and bug fixes between Version 3.6 and Version 3.7 that were part of the development of Version 3.7. These have not been documented. Since the release of the non-beta version of Version 3.7, we have kept a list of code fixes and enhancements. Also, we have included below a series of tables with code fixes for Version 3.6 and earlier versions as a reference to earlier versions.

W2 V3.6 BUG FIXES, ENHANCEMENTS, AND USER MANUAL CHANGES

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
1	W2	TKE1 model	The variable STRICK was incorrectly allocated as an INTEGER rather than REAL.	10/11/2008
2	W2	PIPE	Code was streamlined in the subroutine ZBRENT where calls were made directly to CDFUNC rather than through the dummy function FUNC	10/11/2008
3	W2 Manual	Z0	The User Manual had Z0 in an incorrect line in the control file (w2_con.npt). The write up and example control file in the User Manual were corrected.	10/28/2008
4	W2	Longitudinal profile input	The W2 program did not read initial constituent concentrations in the longitudinal profile file when CCC was 'OFF'. This has been fixed.	12/4/2008
5	W2	TECPLOT output	When using TECPLOT output for multiple waterbodies, the output format did not allow loading the information into TECPLOT. Fixed.	1/26/2009

6	W2	Epiphyton input	For entering vertical profile data for periphyton, there was an index error:
			OLD CODE:
			IF (VERT_EPIPHYTON(JW,JE)) EPD(:,I,JE) = EPIVP(K,JW,JE)
			NEW CODE:
			IF (VERT_EPIPHYTON(JW,JE)) EPD(:,I,JE) = EPIVP(:,JW,JE)
				5/21/2009

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
7	PreW2	Constituent loads	An enhancement was added to the Preprocessor to compute loads in kg/day for all inflow, tributary and distributed tributaries. Also, these are summed up for the model application. These are shown in the file "pre.opt". These are approximate loads since the concentration data are used to set the frequency of loading update. Flow rates at the time of the concentration input data are used to compute load.	5/21/2009

8	W2	Gas transfer at spillways	A couple code fixes in the hydroinout.f90 subroutine:
			(1) CGAS needed to be initialized in some cases to CGAS=C2(K,ID,CN(JC)) prior to calling the subroutine TOTAL_DISSOLVED_GAS for use in the Butts and Evans (1983) equation:
			NEW CODE:
			`CGAS=C2(K,ID,CN(JC))  ! MM 5/21/2009`
			(2) Change logic in several lines from
			IF(CAC(NDO) == ' ON' to
			IF(CAC(NDO) == ' ON' .and. CN(JC)==NDO
			NEW CODE:
			`IF (CN(JC)==NDO .AND. CAC(NDO) == ' ON' .AND. GASSPC(JS) == ' ON' .AND. QSP(JS) > 0.0) THEN`
			! MM 5/21/2009
				5/21/2009

9	W2	Reaeration from dams	An error was found in the formulae from Butts and Evans (1983).
			OLD CODE:
			`DB = SAT-C`
			`DA = DB*(1.0+0.38*AGASGT(N)*BGASGT(N)*CGASGT(N)*(1.0-0.11*CGASGT(N))*(1.0+0.046*T))`
			`C = SAT-DA`
			NEW CODE:
			`DA = SAT-C`
			`! MM 5/21/2009 DA: Deficit upstream`
			`DB = DA/(1.0+0.38*AGASSP(N)*BGASSP(N)*CGASSP(N)*(1.0-0.11*CGASSP(N))*(1.0+0.046*T))`
			`! DB: deficit downstream`
			`C = SAT-DB`
				5/21/2009

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
10	W2	Order of flux parameters	The order of flux parameters in the User Manual and output were incorrect. The control file has them in this order: RPOMSET CBODDK **DOAP** **DOAR** **DOEP** **DOER** DOPOM DODOM DOOM whereas the code assumed they were in this order: RPOMSET CBODDK **DOAP** **DOEP** **DOAR** **DOER** DOPOM DODOM DOOM This has been corrected. The User Manual and control file order is now reflected in the W2 code.	6/2/2009

11	Pre	False errors for inflow location	The preprocessor sometimes gave false errors in the pre.err for tributary, internal weirs, pipes, and other hydraulic features saying that the pipe or tributary was below the elevation of the bottom of the segment. The W2 model ran fine even with this error message given in the preprocessor. This has been fixed.
			
			Example of OLD CODE:
			`IF (EBTR(JT) < EL(KB(ITR(JT)+1),ITR(JT))) THEN`
			`CALL ERRORS`
			`WRITE (ERR,FMTFI) 'Inflow placement bottom elevation [EBTR=',EBTR(JT),'] < bottom active cell elevation for tributary ',JT`
			
			New CODE:
			`IF (EBTR(JT) < EL(KB(ITR(JT))+1,ITR(JT))) THEN`
			`CALL ERRORS`
			`WRITE (ERR,FMTFI) 'Inflow placement bottom elevation [EBTR=',EBTR(JT),'] < bottom active cell elevation for tributary ',JT`
				6/18/09

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
12	Pre	Additional error checking	Additional error checking was added to help debug an error in the bathymetry file when the problem was in the branch connectivity specifically BS and BE. Also, a false error was given when the temperature had an isothermal initial condition, constituents were OFF, and an initial concentration was set to "-2". This was fixed.	6/22/09
13	Pre	Command line processing and working directory displayed for windows	In the windows version of the preprocessor, the user can now supply a command line argument that sets the working directory of the code. Hence, one does not need to copy the preprocessor into every directory. In a batch file, for example, one can execute the following command: `preW2_ivf.exe "C:\scott\w2workshop\2009 workshop\waterqual\problem3"` The preprocessor now uses the supplied directory (in double quotes) as the working directory for all the files. The command line argument has one blank space between the end of the executable and the first quote. Also, the working directory is now displayed at the top of the window. Additional checks were also added for checking the grid linkage.	9/12/09

14	W2	# of processors	The model user can now control the # of physical processors the model uses. At this point, dual-processor model runs have shown an improvement of about 20% over a single processor. But, QUAD processors usually are slower. It is recommended that NPROC be set to 2 in the control file. The user can experiment on his/her own system. If this is not set by the user or is left blank, the model still runs but sets it to 2 processors.
			
			`GRID NWB NBR IMX KMX NPROC CLOSEC`
			`1 1 23 22 2 ON`
				9/12/09

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
15	W2	Command line processing for windows	In the windows version of the w2 model, the user can now supply a command line argument that sets the working directory of the code. Hence, one does not need to copy the model executable into every directory. In a batch file, for example, one can execute the following command: `W2_ivf.exe "C:\scott\w2workshop\2009 workshop\waterqual\problem3"` The w2 model now uses the supplied directory (in double quotes) as the working directory for all the files. The command line argument has one blank space between the end of the executable and the first quote. The working directory is displayed in a text box in the window.	9/12/09

16	W2	W2 window closed at end of successful execution	At the end of a windows run, the windows dialog box waits for the user to press 'close' to exit the window. This allows the user to examine the final run parameters. In the w2_con.npt file there is now an option to close this window when the run has completed. If this option is not set, then the dialog box will stay until the user clicks 'close'.
			
			This allows for efficient batch processing of the model, especially if user in conjunction with command line processing mentioned in #15.
			
			`GRID NWB NBR IMX KMX`
			`NPROC CLOSEC`
			`1 1 23 22`
			`0 ON`
			
			When CLOSEC is set to ON, then the dialog box will disappear once the run finishes. If it is set to OFF, then the dialog box will remain until the user clicks 'close'.
				9/12/09

17	User Manual	Updates	Updates and changes to the control file (#13-#16) were reflected in an updated User Manual.	9/12/09

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
18	GUI	Updates	The GUI was updated with the following: (1) new control file parameters NPROC and CLOSEC were added (see #14 and 16). There is also a SELECTC that will be used in V3.7 that has been included – ignore it for now. (2) The GUI also can be controlled by command line passing of the working directory and file. In a batch program or from the command line in a DOS box you can execute the GUI as follows: `"C:\scott\research\corps of engineers\tomcole\w2code\GUI36\w2control\w2control36.exe" C:\scott\w2workshop\2009 workshop\waterqual\problem1\w2_con.npt` The first string in quotes executes the GUI. The command line argument is NOT in quotes. This program was developed in VB6 and does not take quotes around the command line. Note that this is different than the FORTRAN command line argument. So the above command will open the GUI and load the control file automatically. (3) A text box now shows the file path and name of the file that you are working on (4) In file open, earlier all *.npt files were shown. Since only "w2_con.npt" files are loaded into the GUI, only the "w2_con.npt" file was shown for opening.	9/12/09

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

19	W2	Gates, spillways, pipes	Whenever DOWN was specified for a gate, spillway or pump, the model estimated the water level at the end of the segment, rather than using the branch center water level. This is important in sloping river systems where a long segment may have a water surface elevation drop between the segment center and the edge. In the past this was computed assuming the slope of the channel. This was updated to estimate the water surface elevation using linear interpolation rather than the grid slope. Below is an example of the code fix – in this case for GATES:
			
			OLD CODE:
			`ELIU=ELWS(IUGT(JG))-`
			`SINA(JBUGT(JG))*DLX(IUGT(JG))*0.5`
			
			NEW CODE:
			`ELIU= ELWS(IUGT(JG)) + (ELWS(IUGT(JG))-`
			`ELWS(IUGT(JG)-`
			`1))/(0.5*(DLX(IUGT(JG))+DLX(IUGT(JG)-`
			`1)))*DLX(IUGT(JG))*0.5
				9/25/09

20	W2	New executable	A new executable was made using a new release of Intel Version 11 compiler that corrected problems with Windows 7 applications.	9/25/09

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

21	W2	ICE cover algorithm	There were a couple logic errors in the ice cover algorithm. These were corrected below:
			
			!************** Ice thickness
			ICETH(I) = ICETH(I)+ICETHU+ICETH1+ICETH2
			IF (ICETH(I) < ICE_TOL) ICETH(I) = 0.0
			IF (WINTER .AND. (.NOT. ICE_IN(JB))) THEN
			IF (.NOT. ALLOW_ICE(I)) ICETH(I) = 0.0
			END IF
			ICE(I) = ICETH(I) > 0.0
			IF (ICE(I))THEN ! 3/27/08 SW
			ICESW(I) = 0.0
			ELSE
			ICESW(I) = 1.0
			ENDIF
			ICETHU = 0.0
			ICETH1 = 0.0
			ICETH2 = 0.0
			IF (ICETH(I) < ICE_TOL .AND. ICETH(I) > 0.0) ICETH(I) = ICE_TOL
			ELSE
			IF(TERM_BY_TERM(JW))CALL EQUILIBRIUM_TEMPERATURE ! SW 10/20/09 Must call this first otherwise ET and CSHE are 0
			HIA = 0.2367*CSHE(I)/5.65E-8
			! JM 11/08 convert SI units of m/s to English (btu/ft2/d/F) and then back to SI W/m2/C
			! ICETH(I) = MAX(0.0,ICETH(I)+DLT*((RIMT-ET(I))/(ICETH(I)/RK1+1.0/HIA)-(T2(KT,I)-RIMT))/RHOIRL1) ! OLD CODE
			ICETH(I) = MAX(0.0,ICETH(I)+DLT*((RIMT-ET(I))/(ICETH(I)/RK1+1.0/HIA)-HWI(JW)*(T2(KT,I)-RIMT))/RHOIRL1) ! SW 10/20/09 Revised missing HWI(JW)
			ICE(I) = ICETH(I) > 0.0
			ICESW(I) = 1.0
			IF (ICE(I)) THEN
			! TFLUX = 2.392E-7*(RIMT-T2(KT,I))*BI(KT,I)*DLX(I) ! OLD CODE
			TFLUX = 2.392E-7*HWI(JW)*(RIMT-T2(KT,I))*BI(KT,I)*DLX(I) ! SW 10/20/09 Revised missing HWI(JW)
			TSS(KT,I) = TSS(KT,I)+TFLUX
			TSSICE(JB) = TSSICE(JB)+TFLUX*DLT
			ICESW(I) = 0.0
			END IF
			END IF
			END DO
			END IF
			END IF
				10/20/09

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

22	W2	Gates output in QWD file	The following bug was found in defining which branch a gate was located. This affected the output for the withdrawals at a location where there were gates that were not tied to other branches.
			
			Old code:
			`JWUGT(JG) = JW`
			`IF (IDGT(JG) > 0) THEN`
			`DO JB=1,NBR`
			`IF (IDGT(JG) >= US(JB) .AND. IDGT(JG) <= DS(JB)) EXIT`
			`END DO`
			`JBDGT(JG) = JB`
			`DO JW=1,NWB`
			`IF (JB >= BS(JW) .AND. JB <= BE(JW)) EXIT`
			`END DO`
			`JWDGT(JG) = JW`
			`else ! BUG FIX 9/27/07`
			`jbdgt(jp)=1`
			`jwdgt(jp)=1`
			`END IF`
			
			New code:
			`JWUGT(JG) = JW`
			`IF (IDGT(JG) > 0) THEN`
			`DO JB=1,NBR`
			`IF (IDGT(JG) >= US(JB) .AND. IDGT(JG) <= DS(JB)) EXIT`
			`END DO`
			`JBDGT(JG) = JB`
			`DO JW=1,NWB`
			`IF (JB >= BS(JW) .AND. JB <= BE(JW)) EXIT`
			`END DO`
			`JWDGT(JG) = JW`
			`else ! BUG FIX 9/27/07`
			`jbdgt(jg)=1 ! SW 3/24/10`
			`jwdgt(jg)=1 ! SW 3/24/10`
			`END IF`
				3/24/10

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

23	PreW2	Reading of WSC	Reading in of the WSC file was limited to only 100 dates in the preprocessor. This limitation was fixed by the code shown below:
			`!  DO J=1,100`
			`  28995 continue  ! cb 3/26/10`
			`  READ (NPT,'(10F8.0:/(8X,9F8.0))',END=29000) SDAY,(WSC(I),I=1,IMX)`
			`  IF (SDAY <= SDAYO) THEN`
			`  CALL ERRORS`
			`  WRITE (ERR,'(3(A,F0.3))') 'Julian date ',SDAY,' <= previous date of ',SDAYO,' in '//WSCFN`
			`  END IF`
			`  DO I=1,IMX`
			`  IF(WSC(I) <= 0.0)THEN`
			`  CALL ERRORS`
			`  WRITE (ERR,'(A,F0.3,A,I4,A)') 'Julian date ',SDAY,': WSC AT SEG(I)=',I,' <= 0.0 in '//WSCFN`
			`  ENDIF`
			`  IF (WSC(I) > 2.0) THEN`
			`  CALL WARNINGS`
			`  WRITE (WRN,'(A,F0.3,A,I4,A)') 'Julian day ',SDAY,': WSC(I) AT SEG(I)=',I,' > 2.0 in '//WSCFN`
			`  END IF`
			`  IF (WSC(I) > 0.0 .and. wsc(i) < 0.5) THEN`
			`  CALL WARNINGS`
			`  WRITE (WRN,'(A,F0.3,A,I4,A)') 'Julian day ',SDAY,': WSC(I) AT SEG(I)=',I,' < 0.5 in '//WSCFN`
			`  END IF`
			`  ENDDO`
			`  SDAYO=SDAY`
			`  ! ENDDO`
			`  go to 28995  ! cb 3/26/10`
				3/26/10

24	PreW2	Check on LAT or DOWN	Added an enhancement to do a check in case a spillway, pipe, pump, or gate was specified as 'DOWN'. In all cases where 'DOWN' is specified, the segment that the hydraulic structure originates must be at the end of a branch. Additional logic was added to check for this in all the hydraulic structures.	3/26/10
25	W2 Manual	Light extinction, ice	Added more text to the section on computation of light extinction and inserted a missing reference. Revised an equation for clarity in ICE algorithm and added more explanation on how to estimate HICE.	4/13/2010
26	W2 Manual	Precipitation input file	The units of precipitation are in m/s. The example precipitation input file was changed to more realistic values.	4/14/2010

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

27	W2	ICE	Added code to account for the need to compute long wave radiation in case user chose the equilibrium temperature approach. Fixed subscript error in ice melt computation. Also, made the variable TICE double precision since it is assumed double precision in the call to Surface_terms.
			
			New code:
			`IF (ICE(I)) THEN`
			`TICE = TAIR(JW)`
			`DEL = 2.0`
			`J = 1`
			
			`if(tair(jw).ge.5.0)then ! SW 4/19/10`
			`RANLW(JW) = 5.31E-13*(273.15+TAIR(JW))**6*(1.0+0.0017*CLOUD(JW)**2)*0.97`
			`else`
			`RANLW(JW) = 5.62E-8*(273.15+TAIR(JW))**4*(1.-0.261*exp(-7.77E-4*TAIR(JW)**2))*(1.0+0.0017*CLOUD(JW)**2)*0.97`
			`endif`
			
			`RN1=SRON(JW)/(REFL*RHOWCP)*SHADE(I)*(1.0-ALBEDO(JW))*BETAI(JW)+RANLW(JW)`
			`! SW 4/19/10`
			`DO WHILE (DEL > 1.0 .AND. J < 500)`
			`CALL SURFACE_TERMS (TICE)`
			`RN(I) = RN1-RB(I)-RE(I)-RC(I) ! 4/19/10`
			`! RN(I) = SRON(JW)/(REFL*RHOWCP)*SHADE(I)*(1.0-ALBEDO(JW))*BETAI(JW)+RANLW(JW)-RB(I)-RE(JW)-RC(I) ! OLD CODE`
			`DEL = RN(I)+RK1*(RIMT-TICE)/ICETH(I)`
			`IF (ABS(DEL) > 1.0) TICE = TICE+DEL/500.0`
			`J = J+1`
			`END DO`
				4/19/10

28	W2	Evaporation	Units for EV in the SNP file were given in m/s but were actually m^3/s	4/21/10

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

29	W2	Ice	In the ice melt algorithm, SRON should not have been divided by RHOCP in computing RN1 and DEL in the DO WHILE loop should have been ABS(DEL) rather than DEL:
			
			`RN1=SRON(JW)/REFL*SHADE(I)*(1.0-ALBEDO(JW))*BETAI(JW)+RANLW(JW)`
			`! SW 4/19/10 eliminate spurious divsion of SRO by RHOCP`
			`DO WHILE (ABS(DEL) > 1.0 .AND. J < 500)`
			`! SW 4/21/10 Should have been ABS of DEL`
			`CALL SURFACE_TERMS (TICE)`
				4/21/2010

30	PRE	Constituent loading	The output from the preprocessor in the pre.opt file for constituent loading was in kg rather than the output header of kg/day. The output was updated to kg/day by adding the following lines of code:
			
			`cdtload(incdt(1:NACdt(Jb),Jb),jb)=cdtload(incdt(1:NACdt(Jb),Jb),jb)/(jday-tstart)`
			`! CB 5/10/10 Change units to kg/day`
			
			`ctrload(trcn(1:NACtr(Jt),Jt),jt)=ctrload(trcn(1:NACtr(Jt),Jt),jt)/(JDAY-TSTART)`
			`!CB 5/11/10 convert to units of kg/day`
				5/10/10

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

31	W2	Gate, spillways, pipes	In the case where the user has specified that the flow is DOWN, in the case of reverse flow, the model did not assign the flow correctly if the user had no other tributaries or withdrawals specified in the control file. For this rare event, additional code was written to account for this fact. Also, a logic error was discovered in reverse flow for spillways and gates. This was corrected.
			
			New code added to hydroinout.f90:
			
			`JWW = NWD`
			`withdrawals = jww > 0 ! 6/4/10 SW`
			`JTT = NTR`
			`tributaries = jtt > 0 ! 6/4/10 SW`
			`JSS = NSTR`
			`IF (SPILLWAY) THEN`
			…
			`END IF`
			`tributaries = jtt > 0 ! 6/4/10 SW`
			`withdrawals = jww > 0 ! 6/4/10 SW`
			
			`DO JW=1,NWB`
			`KT = KTWB(JW)`
			`DO JB=BS(JW),BE(JW)`
			
			New code in gate-spill-pipe.f90:
			
			For spillway:
			`IF (ISUB == 0) THEN`
			`DLEL = ELIU-ESP(JS)`
			`IF (ELID > ESP(JS)) DLEL = ELIU-ELID`
			`! SW 6/7/10`
			`IF (DLEL < 0.0) THEN`
			`DLEL = -DLEL`
			For gates:
			`IF (A2GT(JG) == 0.0 .AND. G2GT(JG) /= 0.0) DLEL = ELIU-G2GT(JG)`
			`IF (ELID > EGT(JG)) DLEL = ELIU-ELID`
			`! SW 6/7/10`
			`IF (DLEL < 0.0) THEN`
				6/4/10

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

32	W2	Branch intersections with multiple waterbodies	In cases where there are branch intersections between waterbodies, it was possible that the variable KBI and KB were incorrectly set. Here is the fix: Move the statement defining KBI in the subroutine init-geom.f90 to the place shown below (delete the earlier reference):
			
			`IF (B(K,ID+1) == 0.0) B(K,ID+1) = B(K-1,ID+1)`
			`IF (IEXIT == 1) EXIT`
			`END IF`
			`END IF`
			`END IF`
			`END DO`
			`END DO ! SW 1/23/06`
			`END DO ! SW 1/23/06`
			`bnew=b ! SW 1/23/06`
			`KBI = KB ! SW 10/30/2010`
			
			`!**** Upstream active segment and single layer ! 1/23/06 entire section moved SW`
			`DO JW=1,NWB`
			`KT = KTWB(JW)`
			`DO JB=BS(JW),BE(JW)`
				10/30/2010

33	W2	SS resuspension	The code index was incorrect in the loop for computing resuspension. This led in some compilers to an infinite loop.
			The corrected code is shown below:
			
			`SSSS(KT,I,J) = -SSS(J)*SS(KT,I,J)*BI(KT,I)/BH2(KT,I)+SSR`
			`! DO K=KT-1,KB(I)-1`
			`DO K=KT,KB(I)-1`
			`! JP 2/3/12`
			`IF (SEDIMENT_RESUSPENSION(J)) THEN`
			
			Thanks to James Pasley for this bug report/fix.
				2/3/2012

W2 V3.5 Bug Fixes, Enhancements, and User Manual Changes

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
1	W2	Zooplank-ton-algae	Sign error in the zooplankton grazing on algae term	8/23/06
2	W2	Input/output	Format for I/O was changed to allow better decimal precision of output	8/23/06

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

3	W2	Sediment settling rate	The sediment settling rate was accidentally used for POM settling. This was fixed. The old and new code lines are shown below:
			OLD:
			`sedsum = sedsum+seds(JW)*(LPOM(K,I)*lpomdk(jw)+ RPOM(K,I)*rpomdk(jw))*BI(K,I)/BH2(K,I) *(1.0-BI(K+1,I)/BI(K,I))`
			NEW:
			`sedsum = sedsum+poms(JW)*(LPOM(K,I)*lpomdk(jw)+ RPOM(K,I)*rpomdk(jw))*BI(K,I)/BH2(K,I) *(1.0-BI(K+1,I)/BI(K,I)) ! cb 10/22/06`
			
			This was an issue in the SEDIMENT, SEDIMENT C, SEDIMENT P, SEDIMENT N, and SEDIMENT DECAY RATE subroutines.
				10/26/06

4	W2	Sediment burial	An algorithm was added for sediment burial. This is now a new parameter in the sediment part of the control file. An updated user manual description is forthcoming. The sediment burial rate SEDB (day^{-1}) can be specified in the "SEDIMENT" card section of the control file. A different burial rate can be specified for each water body.
			
			OLD/NEW line (example):
			`! SED(K,I) = MAX(SED(K,I)+(LPOMEP(K,I)+SEDAS(K,I)+S EDOMS(K,I)+SEDNS(K,I)- SEDD(K,I))*DLT,0.0)`
			`SED(K,I) = MAX(SED(K,I)+(sedem+SEDAS(K,I)+sedcb(k ,i)+SEDOMS(K,I)+SEDNS(K,I)-SEDD(K,I)- sedbr(k,i))*DLT,0.0) ! cb 11/30/06`
				11/30/06

5	Control File	Add burial rate for sediment model	This is the change in #4 above implemented in the control file. The new variable SEDBR is added in f8 format after the FSED variable. SEDBR: sediment burial rate in units of per day. `SEDIMENT SEDC SEDPRC SEDCI SEDK SEDS FSOD FSED SEDBR WB 1 ON ON 0.00000 0.10000 0.1 1.00000 1.00000 1.0`	

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

6	W2	Sediment heating and sediment processes	If a model added and subtracted layers that resulted in segment addition and subtraction, there was the possibility that sediment fluxes were incorrectly computed.
			In the NO3 subroutine:
			Old code:
			`NO3SED(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I)-BI(K+1,I))/BH2(K,I)`
			New code:
			`if(k == kb(i)) then`
			`NO3SED(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I))/BH2(K,I)`
			`else`
			`NO3SED(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I)-BI(K+1,I))/BH2(K,I)`
			`endif`
			
			New code added in sediment routine:
			`if(k == kb(i))then ! SW 4/18/07`
			`SODD(K,I) = SOD(I)/BH2(K,I)*SODTRM(K,I)*BI(K,I)`
			`else`
			`SODD(K,I) = SOD(I)/BH2(K,I)*SODTRM(K,I)*(BI(K,I)-BI(K+1,I))`
			`Endif`
			New code added in suspended solids routine:
			`if(k == kb(i))then`
			`SSR = EPSILON*DLX(I)*BI(K,I)/VOL(K,I)`
			`else`
			`SSR = EPSILON*DLX(I)*(BI(K,I)-BI(K+1,I))/VOL(K,I)`
			`Endif`
				4/18/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

6	W2	(see above)	New code added for heat flux to channel bottom:
			`if(kt == kb(i))then ! SW 4/18/07`
			`SROSED = SROOUT*TSEDF(JW)`
			`else`
			`SROSED = SROOUT*(1.0-BI(KT+1,I)/BI(KT,I))*TSEDF(JW)`
			`Endif`
			
			`if(k==kb(i))then ! SW 4/18/07`
			`TFLUX = CBHE(JW)/RHOWCP*(TSED(JW)-T2(K,I))*BI(K,I)*DLX(I)`
			`else`
			`TFLUX = CBHE(JW)/RHOWCP*(TSED(JW)-T2(K,I))*(BI(K,I)-BI(K+1,I))*DLX(I)`
			`endif`
			
			New code added for sediment subroutine:
			`if(k == kb(i))then ! SW 4/18/07`
			`SEDAS(K,I) = SEDAS(K,I)+MAX(AS(JA),0.0)*ALG(K,I,JA)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`else`
			`SEDAS(K,I) = SEDAS(K,I)+MAX(AS(JA),0.0)*ALG(K,I,JA)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`endif`
			`if(k == kb(i))then ! SW 4/18/07`
			`SEDOMS(K,I) = POMS(JW)*(LPOM(K,I)+RPOM(K,I))*BI(K,I)/BH2(K,I)`
			`SEDSO = POMS(JW)*SED(K,I)*BI(K+1,I)/BH2(K,I)`
			`else`
			`SEDOMS(K,I) = POMS(JW)*(LPOM(K,I)+RPOM(K,I))*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`SEDSO = POMS(JW)*SED(K,I)*BI(K+1,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`endif`
				4/18/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

7	W2	Zoo-plankton fixes	Several fixes in the zooplankton routine were made. Many thanks to Dr. Kellie Vache, Institute for Landscape Ecology and Resources Management (ILR) Justus-Liebig-University Giessen Heinrich-Buff-Ring 26 35392 Giessen, Germany, for finding these which are documented below:
			`DO K=KT,KB(I)`
			`do jz = 1, nzp`
			`zgztot=0.0`
			`!kv 5/9/2007`
			`do jjz = 1,nzp`
			`! zooss(k,i,jz)= (zmu(k,i,jz)*zeff(jz)-zrt(k,i,jz)- zmt(k,i,jz))*zoo(k,i,jz) - zgz(k,i,jz,jjz)*zoo(k,i,jz) ! omnivorous zooplankton`
			`zgztot=zgztot+zgz(k,i,jz,jjz)*zoo(k,i, jz) !kv 5/9/2007`
			`end do`
			`zooss(k,i,jz)= (zmu(k,i,jz)*zeff(jz)-zrt(k,i,jz)- zmt(k,i,jz))*zoo(k,i,jz) - zgztot ! kv 5/9/2007`
			`end do`
			`do jjz = 1, nzp`
			`! tgraze(k,i,jz) = tgraze(k,i,jz) + prefz(jz,jjz)*zoo(k,i,jjz)`
			`tgraze(k,i,jz) = tgraze(k,i,jz) + prefz(jjz,jz)*zoo(k,i,jjz)`
			`!cb 5/17/2007`
			`end do`
			`do jjz = 1,nzp ! omnivorous zooplankton`
			`! ZGZ(k,i,jjz,jz) = Zmu(K,I,jz)*ZOO(K,I,jz)*prefZ(jz,jjz)/ tgraze(K,I,jz)`
			`ZGZ(k,i,jjz,jz) = Zmu(K,I,jz)*ZOO(K,I,jz)*prefZ(jjz,jz)/ tgraze(K,I,jz) !kv 5/9/2007`
			`end do`
				5/21/07

8	PRE	More checks	Added checks for Sediment burial rate and some further checks on grid geometry; added output on SEDS and SEDBR to the pre.opt file; fixed condition where NZP had to equal 1 to work.	6/2/2007

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
9	W2	Array deallocation	The deallocate command on line 7557 was commented out to avoid a deallocation error when the 'STOP' button is pushed during execution on a PC. `!  deallocate (sedbr,sedbrp,sedbrn,sedbrc)  ! SW 6/4/07 No need to deallocate pointers`	6/4/2007

10	W2	Initialization of IUT	For code setting up an external head BC, the variable IUT was not initialized before it was used. This was fixed below:
			`!**** Boundary bottom layers`
			`!  IF (UH_EXTERNAL(JB)) KB(IUT-1) = KB(IUT)`
			`  IF (UH_EXTERNAL(JB)) KB(IU-1) = KB(IU)  !cb 6/12/07`
			`  IF (UH_INTERNAL(JB)) THEN`
			`  IF (JBUH(JB) >= BS(JW) .AND. JBUH(JB) <= BE(JW)) THEN`
			`!  KB(IUT-1) = MIN(KB(UHS(JB)),KB(IUT))`
			`  KB(IU-1) = MIN(KB(UHS(JB)),KB(IU))`
			`!cb 6/12/07`
			`  ELSE`
			`!  IF (EL(KB(IUT),IUT) >= EL(KB(UHS(JB)),UHS(JB))) THEN`
			`  IF (EL(KB(IU),IU) >= EL(KB(UHS(JB)),UHS(JB))) THEN  !cb 6/12/07`
			`!  KB(IUT-1) = KB(IUT)`
			`  KB(IU-1) = KB(IU)`
			`  ELSE`
			`!  DO K=KT,KB(IUT)`
			`!  IF (EL(KB(UHS(JB)),UHS(JB)) >= EL(K,IUT)) THEN`
			`!  KB(IUT-1) = K; EXIT`
			`  DO  K=KT,KB(IU)`
			`!cb 6/12/07`
			`  IF (EL(KB(UHS(JB)),UHS(JB)) >= EL(K,IU)) THEN  !cb 6/12/07`
			`  KB(IU-1) = K; EXIT`
			`!cb 6/12/07`
			`  END IF`
				6/17/2007

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
11	W2	CBOD settling	The CBOD settling rate earlier was not converted from m/d in the control file to m/s in the code. Added code: `cbods = cbods/day !cb 7/23/07`	7/23/07

12	W2	TSR output	The surface width was not correctly being output. Changed BI(KT) to BI(KTWB(JW)).
			
			`FIX:`
			`BI(KTWB(JW),I),SHADE(I),ICETH(I),(ADJU STR(C2CH(JAC)),JAC=1,NAC),`
			`& ! CB 7/26/07`
				7/26/07

13	PREW2	Pumps	The pump control for DOWN or LAT was not being checked properly, also a check on IUPUC was incorrect. Fixed.	8/14/07

14	W2	Algae	The logic for negative settling velocities for algae had an error.
			Old code:
			`! ASR(K,I,JA) = - AS(JA)*(ALG(K+1,I,JA)*B(K+1,I)/(B(K,I) *H2(K,I))-`
			`ALG(K,I,JA))*BI(K,I)/BH2(K,I)`
			New code:
			
			`ASR(K,I,JA) = - AS(JA)*(ALG(K+1,I,JA)*BI(K+1,I)/BH2(K, I)-ALG(K,I,JA)*BI(K,I)/BH2(K,I))`
			`!SP 8/27/07`
			Shwet Prakash
				8/27/07

15	GUI	NZOOP	When # of zooplankton was set equal to zero, there was an array dimensioning error that caused the writing of the control file to only proceed part way. Fixed.	9/17/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

16	W2	Open channel flow	Variable passed between subroutines had inconsistent declaration between routines.
			`! REAL, ALLOCATABLE, DIMENSION(:) :: Y, D, B, V, CAREA, TOPW, BELEV, Q, VOLD, YOLD`
			
			`REAL, ALLOCATABLE, DIMENSION(:) :: Y, B, V, CAREA, TOPW, BELEV, Q, VOLD, YOLD ! cb 10/1/07`
			
			`! ALLOCATE (Y(NN), V(NN), CAREA(NN), TOPW(NN), BELEV(NN), Q(NN), VOLD(NN), YOLD(NN), D(NN), B(NN))`
			
			`ALLOCATE (Y(NN), V(NN), CAREA(NN), TOPW(NN), BELEV(NN), Q(NN), VOLD(NN), YOLD(NN), B(NN)) ! cb 10/1/07`
			
			`! DEALLOCATE (Y, V, CAREA, TOPW, BELEV, Q, VOLD, YOLD, D, B, YT, VT, VPR, YPR, TAREA, TOPWT, RT, INDX, AL, DAA)`
			
			`DEALLOCATE (Y, V, CAREA, TOPW, BELEV, Q, VOLD, YOLD, B, YT, VT, VPR, YPR, TAREA, TOPWT, RT, INDX, AL, DAA) ! cb 10/1/07`
				10/4/07

17	W2	TKE model	The TKE algorithm had several bugs that have been fixed, these included making the loop over layers go to KBMIN (rather than KB), the original code overwrote the boundary conditions when using the Thomas algorithm, the original code overwrote vertical eddy viscosity at the bed during the averaging process, Δz_k changed to $\Delta z_{k+1/2}$, TKE array was initialized to zero, TKE was implemented in add/sub layers like AZ. Many of these fixes are a result of the work of Sam Gould (Gould, 2006) who wrote an MS project report at PSU entitled "k-e Turbulence Model." Further recommendations by Gould (2006) will be incorporated into the next version of CE-QUAL-W2. The old code is shown below as a reference to the new code in the release version. OLD CODE	10/4/07

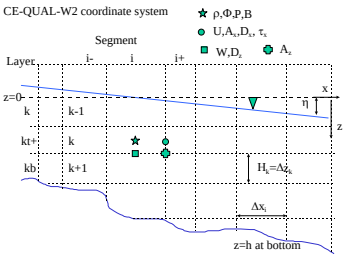
#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

			ENTRY CALCULATE_TKE
			  USTAR = SQRT(1.25*CZ(I)*WIND10(I)**2/RHO(KT,I))
			  IF (MANNINGS_N(JW)) THEN
			  HRAD = BHR1(KT,I)/(BR(KTI(I),I)-BR(KT+1,I)+2.*AVH1(KT,I))
			if(macrophyte_on.and.mannings_n(jw))then
			  call macrophyte_friction(hrad,fric(i),effric,kt,i)
			gc2=g*effric*effric/hrad**0.33333333
			  else if(.not.macrophyte_on.and.mannings_n(jw))then
			gc2=g*fric(i)*fric(i)/hrad**0.33333333
			  end if
			  ELSE
			  GC2 = 0.0
			  IF (FRIC(I) /= 0.0) GC2 = G/(FRIC(I)*FRIC(I))
			  END IF
			  USTARB = SQRT(GC2)*ABS(0.5*(U(KT,I)+U(KT,I-1)))
			  TKE(KT,I,1) = 0.5*(3.33*(USTAR*USTAR+USTARB*USTARB)+TKE(KT,I,1))*(BH2(KT,I)/BH1(KT,I))
			  TKE(KT,I,2) = 0.5*(USTAR*USTAR*USTAR+USTARB*USTARB*USTARB*5.0/H1(KT,I)+TKE(KT,I,2))*(BH2(KT,I)/BH1(KT,I))
			  DO K=KT+1,KB(I)-1
			  BOUK = MAX(AZ(K,I)*G*(RHO(K+1,I)-RHO(K,I))/(H(K,JW)*RHOW),0.0)
			  PRDK = AZ(K,I)*(0.5*(U(K,I)+U(K,I-1)-U(K+1,I)-U(K+1,I-1))/H(K,JW))**2.0
			  PRHE = 10.0*GC2**1.25*ABS(0.5*(U(K,I)+U(K,I-1)))**4.0/(0.5*B(K,I))**2.0
			  IF (MANNINGS_N(JW)) THEN
			! v3.5 start
			  HRAD = BHR(K,I)/(BR(K,I)-BR(K+1,I)+2.0*H(K,JW))
			! GC2 = G*FRIC(I)*FRIC(I)/HRAD**0.333
			
			if(macrophyte_on.and.mannings_n(jw))then
			  call macrophyte_friction(hrad,fric(i),effric,k,i)
			
			gc2=g*effric*effric/hrad**0.33333333
			  else if(.not.macrophyte_on.and.mannings_n(jw))then
			
			gc2=g*fric(i)*fric(i)/hrad**0.33333333	

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

			end if
			! v3.5 end
			END IF
			PRHK = GC2/(0.5*B(K,I))*ABS(0.5*(U(K,I)+U(K,I-1)))**3.0
			UNST = PRDK-TKE(K,I,2)
			UNSE = 1.44*TKE(K,I,2)/TKE(K,I,1)*PRDK-1.92*(TKE(K,I,2)/TKE(K,I,1)*TKE(K,I,2))
			TKE(K,I,1) = TKE(K,I,1)+DLT*(UNST+PRHK-BOUK)
			TKE(K,I,2) = TKE(K,I,2)+DLT*(UNSE+PRHE)
			END DO
			USTARB = SQRT(GC2)*ABS(0.5*(U(KB(I),I)+U(KB(I),I-1)))
			TKE(KB(I),I,1) = 0.5*(3.33*USTARB*USTARB+TKE(KB(I),I,1))
			TKE(KB(I),I,2) = 0.5*(USTARB*USTARB*USTARB*5.0/H(KB(I),JW)+TKE(KB(I),I,2))
			AT = 0.0; CT = 0.0; VT = 0.0; DT = 0.0
			DO J=1,2
			DO K=KT,KB(I)
			AT(K,I) = -DLT/BH1(K,I)*BB(K-1,I)/SIG(J)*AZ(K-1,I)/AVH1(K-1,I)
			CT(K,I) = -DLT/BH1(K,I)*BB(K,I)/SIG(J)*AZ(K,I)/AVH1(K,I)
			VT(K,I) = 1.0-AT(K,I)-CT(K,I)
			DT(K,I) = TKE(K,I,J)
			END DO
			CALL TRIDIAG(AT(:,I),VT(:,I),CT(:,I),DT(:,I),KT,KB(I),KMX,TKE(:,I,J))
			END DO
			DO K=KT,KB(I)
			TKE(K,I,1) = MAX(TKE(K,I,1),TKEMIN1)
			TKE(K,I,2) = MAX(TKE(K,I,2),TKEMIN2)
			AZ(K,I) = 0.09*TKE(K,I,1)*TKE(K,I,1)/TKE(K,I,2)
			END DO
			! Center at cell faces
			DO K=KT,KB(I)-1
			AZ(K,I) = 0.5*(AZ(K,I)+AZ(K+1,I))
			AZ(K,I) = MAX(AZMIN,AZ(K,I))
			AZ(K,I) = MIN(AZMAX(JW),AZ(K,I))
			DZ(K,I) = MAX(DZMIN,FRAZDZ*AZ(K,I))
			END DO	

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
18	W2	Restart	Added TKE to restart variables written out and read in.	10/5/07
19	GUI	ET	The equilibrium temperature option in the drop down menu was 'EQT' rather than 'ET'. Fixed.	10/9/07
20	W2	Sediment	The SEDIMENT subroutine did not have any computational mistakes, just an error in assigning all array variables to the value at K,I. This resulted in excessive computational time. The fix is shown below: OLD sedbr = sedb(jw)*sed(k,i) NEW sedbr(K,I) = sedb(jw)*sed(k,i)	10/15/07

21	W2	TKE	Turbulence model had an improper averaging between layers. A new temporary variable was defined to temporarily store the values for AZ prior to averaging to the bottom/top of the layers and the horizontal layers. This also affected the computation of DZ. Fixed.
			
			New code defined AZT and allocated memory for it, such that
			`AZT(K,I) = 0.09*TKE(K,I,1)*TKE(K,I,1)/TKE(K,I,2)`
			and
			`AZ(K,I) = 0.5*(AZT(K,I)+AZT(K+1,I))`
			
			Similarly for the horizontal averaging and for DZ. Also, the values of DZ were fixed to be at the bottom of a cell and AZ was fixed to be at the bottom right-hand edge of a cell as shown below:
			 
				12/17/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

22	W2	SS settling	The incorrect cell width was used for SSSO. BI(KT,I) was changed to BI(K,I).
			
			OLD CODE:
			`SSSO(K,I) = (TOTSS0+FES(JW)*FPFE(K,I))*BI(KT,I)/BH2(K,I)*DO1(K,I)`
			`FPSS(K,I) = FPSS(K,I)*TISS(K,I)`
			NEW CODE:
			`SSSO(K,I) = (TOTSS0+FES(JW)*FPFE(K,I))*BI(K,I)/BH2(K,I)*DO1(K,I)`
			`FPSS(K,I) = FPSS(K,I)*TISS(K,I)`
				12/17/07

23	W2	Initial-ization of one-layer	The definition of KBMIN was not updated if the model started out in some segments with only one_layer. This has been fixed.
			
			Added code highlighted:
			`DO I=IU,ID`
			`IF (KB(I)-KT < NL(JB)-1) IUT = I+1`
			`ONE_LAYER(I) = KT == KB(I)`
			`END DO`
			`CUS(JB) = IUT`
			`! reinitialize KBMIN`
			`DO I=IU-1,ID`
			`KBMIN(I) = MIN(KB(I),KB(I+1))`
			`END DO`
			`KBMIN(ID+1) = KBMIN(ID)`
			
			`!**** Areas and bottom widths`
			
			`IF (.NOT. TRAPEZOIDAL(JW)) THEN`
				12/17/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

24	W2	Bottom processes	This is a couple more fixes related to bug fix #6 above. The Denitrification rate and epiphyton burial rates could be affected based on unique combinations of adding/subtracting segments that left the value of BI in an inactive layer below KB defined incorrectly. In order to prevent the possibility of problems, the following fixes were made:
			
			Old Code:
			`sedNO3(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I)-BI(K+1,I))/BH2(K,I)`
			
			`EPM(K,I,J) = EPD(K,I,J)*(BI(K,I)-BI(K+1,I)+2.0*H1(K,I))*DLX(I)`
			
			New code:
			`if(k == kb(i)) then ! SW 12/16/07`
			`sedNO3(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I))/BH2(K,I)`
			`else`
			`sedNO3(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I)-BI(K+1,I))/BH2(K,I)`
			`endif`
			
			`if(k == kb(i)) then ! SW 12/16/07`
			`EPM(K,I,J) = EPD(K,I,J)*(BI(K,I)+2.0*H1(K,I))*DLX(I)`
			`else`
			`EPM(K,I,J) = EPD(K,I,J)*(BI(K,I)-`
			`BI(K+1,I)+2.0*H1(K,I))*DLX(I)`
			`endif`
				12/17/2007

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

25	W2	CBODS	If the user defined particulate CBOD that settles to the bottom and had SED turned ON, the conversion from oxygen to organic matter was missing in the accumulation on the channel bottom or sides.
			
			OLD
			`do jd=1,nbod`
			`SEDcb(K,I) = SEDcb(K,I)+MAX(cbods(jd),0.0)*cbod(K,I,Jd)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`end do`
			NEW
			`do jd=1,nbod`
			`SEDcb(K,I) = SEDcb(K,I)+MAX(cbods(jd),0.0)*(cbod(K,I,Jd)/O2OM(JW))*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`! 1/16/08`
			`end do`
				1/18/08

26	W2	SEDBR	Eliminated a redundant definition of SEDBR in the Sediment routine since it is already defined in the Kinetic rates subroutine.	1/18/08

27	W2	SEDDK	The first order sediment decay rate is an average of the decay rates of all the influxes of organic matter and their respective decay rates. There was an error in computing this average decay rate for CBOD treated as particulate. Code fix is shown below:
			
			OLD
			`do jd=1,nbod`
			`sedsum = sedsum+MAX(cbods(jd),0.0)*cbod(K,I,Jd)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`end do`
			
			NEW
			`do jd=1,nbod`
			`sedsum = sedsum+MAX(cbods(jd),0.0)*cbod(K,I,Jd)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))*RBOD(JD)*CBODD(K,I,JD)/O2OM(JW)`
			`end do`
				1/18/08

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

28	W2	SRO	There are some cases when segments were added/subtracted that the value of BI was not correctly initialized. This code is a fix to prevent such occurrences:
			
			OLD CODE:
			SRONET = SROIN-SROOUT
			SROSED = SROOUT*(1.0-BI(K+1,I)/BI(K,I))*TSEDF(JW)
			
			NEW CODE:
			SRONET = SROIN-SROOUT
			if(k /= kb(i))then ! SW 1/18/08
			SROSED = SROOUT*(1.0-BI(K+1,I)/BI(K,I))*TSEDF(JW)
			else
			SROSED = SROOUT*TSEDF(JW)
			endif
				1/18/2008

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

29	W2	Water Quality	Added several calls to prevent computation of kinetic variables if epiphyton are defined in the control file with NEP=1 or more but is not ACTIVE or turned ON. If the kinetic expressions are non-zero and the initial concentration is given, then this could add source/sink terms to the oxygen balance.
			
			This is typical of the code changes – since several of this type were made:
			
			OLD CODE:
			DO JE=1,NEP
			PO4EG(K,I) = PO4EG(K,I)+EGR(K,I,JE)*EPC(K,I,JE)*EP(JE)
			PO4ER(K,I) = PO4ER(K,I)+ERR(K,I,JE)*EPC(K,I,JE)*EP(JE)
			END DO
			
			NEW CODE:
			IF (EPIPHYTON_CALC(JW,JE))then ! SW 1/18/2008
			PO4EG(K,I) = PO4EG(K,I)+EGR(K,I,JE)*EPC(K,I,JE)*EP(JE)
			PO4ER(K,I) = PO4ER(K,I)+ERR(K,I,JE)*EPC(K,I,JE)*EP(JE)
			endif
				1/18/2008

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

30	W2	Bottom processes	Continuation of bug fix #24 in such places as
			
			New code:
			`IF(K == KB(I))THEN`
			`  xdum=BI(K,I)/BH2(K,I)  ! SW 1/18/08`
			`  ELSE`
			`  xdum=BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`  ENDIF`
			
			`  SEDAS(K,I) = SEDAS(K,I)+MAX(AS(JA),0.0)*ALG(K,I,JA)*xdum  ! SW 1/18/08`
			
			`SEDOMS(K,I) = pomS(JW)*(LPOM(K,I)+RPOM(K,I))*xdum !sw 1/18/08 cb 10/22/06`
			`  IF(K==KB(I))THEN  ! SW 1/18/08`
			`  SEDSO = 0.0`
			`  ELSE`
			`  SEDSO = sedS(JW)*SED(K,I)*BI(K+1,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`  Endif`
			
			`DO K=KT,KB(I)`
			`  IF(K == KB(I))THEN`
			`  xdum=BI(K,I)/BH2(K,I)  ! SW 1/18/08`
			`  ELSE`
			`  xdum=BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`  ENDIF`
			`  DO JA=1,NAL`
			`  SEDASp(K,I) = SEDASp(K,I)+MAX(AS(JA),0.0)*ap(ja)*ALG(K,I,JA)*xdum  ! SW 1/18/08`
			`  END DO`
			`  DO JE=1,NEP`
			`  IF (EPIPHYTON_CALC(JW,JE))LPOMEPp(K,I) = LPOMEPp(K,I)+EPOM(JE)*ep(je)*(EMR(K,I,JE)*EPC(K,I,JE))`
			`  END DO`
			`  do jd=1,nbod`
			
			This code is repeated similarly in many of the sediment routines.
				1/18/2008

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
31	W2	Add segment initial-ization	The DEPTHM and DEPTHB were not initialized correctly when a segment was added – this does not affect internal computations, just output for SPR and SNP files. OLD CODE: BKT(I) = BH1(KT,I)/H1(KT,I) DEPTHB(K,I) = H1(KT,I) ! DEPTHM(K,I) = H1(KT,I)*0.5 NEW CODE: BKT(I) = BH1(KT,I)/H1(KT,I) DEPTHB(KT,I) = H1(KT,I) ! SW 1/27/08 DEPTHM(KT,I) = H1(KT,I)*0.5 ! SW 1/27/08	1/27/08

W2 V3.2 Bug Fixes, Enhancements, and User Manual Changes

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
1	W2	Waterbody-waterbody connection	When there was negative velocities at a waterbody-waterbody connection, there was a possibility (dependent on the bathymetry of the connection at the waterbody-waterbody intersection) that there could be temperature or concentration anomalies.	8/31/04
2	W2	Lateral_ withdrawal	Added limit to the DLRHOMAX function: Old code: DLRHOMAX=MAX(DLRHOT,DLRHOB) New code: DLRHOMAX=MAX(DLRHOT,DLRHOB,1.0E-10)	1/25/05

3	W2	Branch connectivity	Logic in branch connectivity set-up was fixed
			Old code:
			IF(UHS(JB) == DS(JJJB))EXIT
			New code:
			IF(abs(UHS(JB)) == DS(JJJB))EXIT
				1/25/05

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

4	W2	Pumpback	Pumpback logic was corrected – this is legacy code that will probably be removed from later versions of W2
			Old code:
			DO JB=1,NBR
			IF (JB == JBP) JWBP = JW
			END DO
			New code:
			DO JW=1,NWB
			DO JB=BS(JW),BE(JW)
			IF(JB == JBP) JWBP = JW
			END DO
			END DO
				1/25/05

5	W2	CPL write	Switched order of implied DO loop on CPL write statement for output of constituents	1/25/05
6	W2	PRF write	Changed output format for PRF output for constituents from f10.2 to e13.6	1/25/05

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
7	W2	Heat balance	Added the Idso and Jackson long wave radiation equation when air temperatures are below 5C. The Swinbank model underpredicts long wave incoming radiation at low air temperatures by as much as 10%. The computation of long wave atmospheric radiation is done using the approach of Swinbank (1963) unless air temperatures are less than 5°C, when the Idso and Jackson (1969) formula is used (Wells, et al., 1982). The Swingbank formula for clear sky long wave atmospheric radiation is $\phi_{ac} = 5.31E-13(T_a + 273)^6$ where units are W/m^2,°C at 2 m height. Below 40°F (5°C) the formula of Idso and Jackson is recommended (above 10°C both equations are almost identical): $\phi_{ac} = \sigma(T_a + 273)^4\left(1 - 0.261\exp(-7.77E-4T_a^2)\right)$ where units are W/m^2 and T_a is in units of °C. The Stefan-Boltzmann constant = 5.62E-8 W/m^2/(°K)^4.	1/25/05

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

7	W2	Layer addition algorithm	Mistyped subscript K instead of I:
			Old code:
			`IF (KB(I) > KBI(I)) THEN`
			`B(KB(K),I) = 0.0`
			`DX(KB(I),I) = 0.0`
			`KB(I) = KB(I)-1`
			`IF (I /= DS(JB)+1) KBMIN(I) = MIN(KB(K),KB(I+1))`
			`IF (I /= US(JB)-1) KBMIN(I-1) = MIN(KB(I-1),KB(I))`
			
			New Code:
			`IF (KB(I) > KBI(I)) THEN`
			`B(KB(I),I) = 0.0 ! SW 3/2/05`
			`DX(KB(I),I) = 0.0`
			`KB(I) = KB(I)-1`
			`IF (I /= DS(JB)+1) KBMIN(I) = MIN(KB(I),KB(I+1)) ! SW 3/2/05`
			`IF (I /= US(JB)-1) KBMIN(I-1) = MIN(KB(I-1),KB(I))`
				3/2/05

8	W2	Variable initialize-tion	In some cases when there was a layer subtraction and a time step violation immediately afterward, the variable SW was not initialized properly. This caused problems in the Tomas Algorithm for the water surface computation. The following line of code was added to the SUB layer algorithm:
			`SW(KT-1,IU-1:ID+1) = 0.0 !TC 3/9/05`
			Also, the variable AVHR was defined in the Update variables for DS+1. The following new code was added:
			
			`AVHR(KT,DS(JB)+1)=H1(KT,DS(JB)+1) !SW 03/08/05`
				3/9/05

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

9	W2	Interpola-tion multipliers	Possible index error if there are multiple waterbodies.
			Old code:
			`RATZ(K,JW) = AVH2(K-1,I)/AVH2(K,I)`
			`CURZ1(K,JW) = 2.0*H(K,JW)**2/(AVH2(K-1,I)+AVH2(K,I))/AVH2(K-1,I)`
			`CURZ2(K,JW) = -2.0*H(K,JW)**2/(AVH2(K-1,I)*AVH2(K,I))`
			`CURZ3(K,JW) = 2.0*H(K,JW)**2/(AVH2(K-1,I)+AVH2(K,I))/AVH2(K,I)`
			`END DO`
			New code:
			`RATZ(K,JW) = AVH2(K-1,DS(BE(JW)))/AVH2(K,DS(BE(JW)))`
			`CURZ1(K,JW) = 2.0*H(K,JW)**2/(AVH2(K-1,DS(BE(JW)))+AVH2(K,DS(BE(JW))))/AVH2(K-1,DS(BE(JW)))`
			`CURZ2(K,JW) = -2.0*H(K,JW)**2/(AVH2(K-1,DS(BE(JW)))*AVH2(K,DS(BE(JW))))`
			`CURZ3(K,JW) = 2.0*H(K,JW)**2/(AVH2(K-1,DS(BE(JW)))+AVH2(K,DS(BE(JW))))/AVH2(K,DS(BE(JW)))`
				5/10/05

10	W2	Spillway and Gates	Older code in order to check if it was submerged or not used the elevation difference relative to the channel bed on either side of the weir, rather than the weir crest. Also removed code line: `IF(ELDN>ESP(JS))DH+ELUP-ELDN`	5/10/05

11	W2	Reaeration	Corrected formula errors in Thackston and Krenkel formula:
			Old code:
			`USTAR=SQRT(ADEPTH*SLOPE(JB)*32.2)**0.5`
			`REAER(I) = 24.88*(1.0+SQRT(0.176*UAVG/SQRT(ADEPTH)))*USTAR`
			New code:
			`USTAR=SQRT(ADEPTH*SLOPE(JB)*32.2)`
			`REAER(I) = 24.88*(1.0+SQRT(0.176*UAVG/SQRT(ADEPTH)))*USTAR/ADEPTH`
			Similar changes were made to the updated Thackston model (Eqn 10)
				5/10/05

12	W2	Violations NV	The variable BI and VOL was not initialized properly during a time-step violation.	8/25/05

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
13	W2	ADD a layer	The variable BI was not initialized properly during an ADD layer.	8/25/05
14	W2	TRIDIAG subroutine	Insert Deallocate Statement in Tridiag SUBROUTINE TRIDIAG(A,V,C,D,S,E,N,U) USE PREC INTEGER, IN TENT(IN) :: S, E, N REAL(R8), DIMENSION(:), INTENT(IN) :: A(E),V(E),C(E),D(E) REAL, DIMENSION(:), INTENT(OUT) :: U(N) REAL(R8), ALLOCATABLE, DIMENSION(:) :: BTA, GMA ALLOCATE (BTA(N),GMA(N)) BTA(S) = V(S) GMA(S) = D(S) DO I=S+1,E BTA(I) = V(I)-A(I)/BTA(I-1)*C(I-1) GMA(I) = D(I)-A(I)/BTA(I-1)*GMA(I-1) END DO U(E) = GMA(E)/BTA(E) DO I=E-1,S,-1 U(I) = (GMA(I)-C(I)*U(I+1))/BTA(I) END DO Deallocate (BTA, GMA) <----- ! SW 10/17/05 END SUBROUTINE TRIDIAG	10/17/05

15	W2	SUB layer	In SUB Layer/Sub Seg - eliminate parentheses which caused a sign error
			IF (.NOT. TRAPEZOIDAL(JW)) THEN
			BI(KT,IU-1) = B(KTI(IU-1),I)
			H1(KT,IU-1) = H(KT,JW)-Z(IU-1)
			BH1(KT,IU-1) = B(KTI(IU-1),IU-1)*(EL(KT,IU-1)-EL(KTI(IU-1)+1,IU-1)-Z(IU-1)*COSA(JB))/COSA(JB) <-----
			! SR 10/17/05
			IF (KT >= KB(IU-1)) BH1(KT,IU-1) = B(KT,IU-1)*H1(KT,IU-1)
			DO K=KTI(IU-1)+1,KT
			BH1(KT,IU-1) = BH1(KT,IU-1)+BH1(K,IU-1)
			END DO
			ELSE
				10/17/05

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

16	W2	SUB layer for shallow systems	Layer SUB - improve model running in shallow segments
			
			!** Water surface minimum thickness
			DO JW=1,NWB
			KT = KTWB(JW)
			ZMIN(JW) = -1000.0
			KTMAX = 2 <----- !
			SR 10/17/05
			DO JB=BS(JW),BE(JW)
			DO I=CUS(JB),DS(JB)
			IF(KB(I) > KTMAX) KTMAX =
			KB(I) <----- ! SR 10/17/05
			IF (Z(I) > ZMIN(JW)) THEN
			IZMIN(JW) = I
			JBIZ = JB
			END IF
			ZMIN(JW) = MAX(ZMIN(JW),Z(I))
			END DO
			END DO
			ADD_LAYER = ZMIN(JW) < -0.85*H(KT-
			1,JW) .AND. KT /= 2
			SUB_LAYER = ZMIN(JW)
			> 0.60*H(KT,JW) .AND. KT < KTMAX <--
			----- ! SR 10/17/05
			....
			!******** Upstream active segment
			IUT = US(JB)
			IF (SLOPE(JB) /= 0.0) THEN
			DO I=US(JB)-1,DS(JB)+1
			IF (KB(I) < KT)THEN <----
			---------- ! SR 10/17/05
			KB(I) =
			KT
			B(KB(I),I) =
			0.000001
			DX(KB(I),I) =
			DXI(JW)
			...
			!****** Additional layer subtractions
			ZMIN(JW) = -1000.0
			DO JB=BS(JW),BE(JW)
			DO I=CUS(JB),DS(JB)
			ZMIN(JW) = MAX(ZMIN(JW),Z(I))
			END DO
			END DO
			SUB_LAYER = ZMIN(JW) >
			0.60*H(KT,JW) .AND. KT < KTMAX <------
			! SR 10/17/05
			END DO
			END DO
			
			Also done for the initial set-up of the branch geometry:
			!**** Upstream active segment and single layer
			
			IF (SLOPE(JB) /= 0.0) THEN
			DO I=US(JB)-1,DS(JB)+1
			IF (KB(I) < KT)
			THEN <----- ! .AND. I
			/= IZMIN(JW) SW 10/17/05
			B(KT,I) = 0.000001
				10/17/05

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

17	W2	Shade algorithm	No errors just an improvement in computational efficiency.
			Delete this from the SHADING subroutine:
			`!** Set the angles for which topographic shade data are available`
			`DO II=1,IANG`
			`ANG(II)=((II-1)*(360.0/FLOAT(IANG)))*PI/180.0`
			`END DO`
			`GAMMA = (2*PI)/IANG`
			and change the 2 occurrences of gamma to gama (only in shading subroutine):
			`ANG2 = (TOPO(I,J+1)-TOPO(I,J))/GAMA <---- ! SW 10/17/05`
			`TOPOANG = TOPO(I,J)+ANG2*ANG1`
			`ENDIF`
			`END DO`
			`IF (AZ00 > ANG(IANG) .AND. AZ00 <= 2*PI) THEN`
			`ANG1 = AZ00-ANG(IANG)`
			`ANG2 = (TOPO(I,1)-TOPO(I,IANG))/GAMA <----! SW 10/17/05`
			ADD a line to the module SHADEC:
			`MODULE SHADEC`
			`PARAMETER (IANG=18)`
			`REAL, PARAMETER :: GAMA=(3.1415926*2.)/REAL(IANG) <--- ! SW 10/17/05`
			`REAL, DIMENSION(IANG):: ANG <----! SW 10/17/05`
			`REAL, ALLOCATABLE, DIMENSION(:) :: A00, DECL, HH, TTLB, TTRB, CLLB, CLRB <------- ! SW 10/17/05`
			`REAL, ALLOCATABLE, DIMENSION(:) :: SRLB1, SRRB1, SRLB2, SRRB2, SRFJD1, SRFJD2,SHADEI`
			`REAL,ALLOCATABLE, DIMENSION(:,:) :: TOPO`
			`LOGICAL, ALLOCATABLE, DIMENSION(:) :: DYNAMIC_SHADE`
			`DATA ANG /0.00000, 0.34907, 0.69813, 1.04720, 1.39626, 1.74533, 2.09440, 2.44346,&`
			`2.79253, 3.14159, 3.49066, 3.83972, 4.18879, 4.53786, 4.88692, 5.23599, 5.58505, 5.93412/ <----- ! SW10/17/05`
			`END MODULE SHADEC`
			Delete allocation statement for ang:
			`ALLOCATE (SRLB1(IMX), SRRB1(IMX), SRLB2(IMX), SRRB2(IMX), SRFJD1(IMX), SHADEI(IMX), SRFJD2(IMX))`
			`ALLOCATE (TOPO(IMX,IANG)) <---- !SW10/17/05`
			`ALLOCATE (QSW(KMX,NWDT), CTR(NCT,NTRT), HPRWBC(NHY,NWB))`
			Delete ang from the deallocate statement:
			`DEALLOCATE(TTLB, TTRB, CLLB, SRLB1, SRRB1, SRLB2, SRRB2, SRFJD1, SHADEI,SRFJD2, TOPO, QSW, CTR) <----! SW 10/17/05`
				10/17/05

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
18	W2	Epiphyton algorithm	Several changes were made that corrected errors in shallow systems where adding and subtracting layers did not reinitialize macrophyte layers when the current KT was below KB; the epiphyton burial rate was greater than specified in the control file; epiphyton that are buried become part of the 1st order organic sediment (as before); epiphyton mortality now becomes part of the LPOM pool (based on the EPOM fraction) and is settled and transported downstream rather than going into the organic 1st order sediment model directly. Currently this is non-photosynthesizing – but we will change in the next version.	5/26/06
19	W2	ADD/SUB layers	There was a bug in addition and subtraction of layers that led to water quality variables not being initialized correctly during riverine shallow flow	5/26/06
20	User Manual	Typos corrected	The manual had a few typos that were corrected.	6/11/2006
21	W2	Waterbody-waterbody connection	The subroutine Upstream_velocity under specific conditions did not maintain flwo continuity across a waterbody-waterbody connection	6/29/2006
22	W2	SNP output	The algal limiting nutrient SNP output had a bug under specific conditions in writing out the information.	6/30/2006

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

23	W2	Sediment heating and sediment processes	If a model added and subtracted layers that resulted in segment addition and subtraction, there was the possibility that sediment fluxes were incorrectly computed.
			
			In the NO3 subroutine:
			Old code:
			`NO3SED(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I)-BI(K+1,I))/BH2(K,I)`
			
			New code:
			`if(k == kb(i)) then`
			`NO3SED(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I))/BH2(K,I)`
			`else`
			`NO3SED(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I)-BI(K+1,I))/BH2(K,I)`
			`endif`
			
			New code added in sediment routine:
			`if(k == kb(i))then ! SW 4/18/07`
			`SODD(K,I) = SOD(I)/BH2(K,I)*SODTRM(K,I)*BI(K,I)`
			`else`
			`SODD(K,I) = SOD(I)/BH2(K,I)*SODTRM(K,I)*(BI(K,I)-BI(K+1,I))`
			`Endif`
			New code added in suspended solids routine:
			`if(k == kb(i))then`
			`SSR = EPSILON*DLX(I)*BI(K,I)/VOL(K,I)`
			`else`
			`SSR = EPSILON*DLX(I)*(BI(K,I)-BI(K+1,I))/VOL(K,I)`
			`Endif`
				4/18/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

23	W2	(see above)	New code added for heat flux to channel bottom:
			`if(kt == kb(i))then ! SW 4/18/07`
			`SROSED = SROOUT*TSEDF(JW)`
			`else`
			`SROSED = SROOUT*(1.0-BI(KT+1,I)/BI(KT,I))*TSEDF(JW)`
			`Endif`
			
			`if(k==kb(i))then ! SW 4/18/07`
			`TFLUX = CBHE(JW)/RHOWCP*(TSED(JW)-T2(K,I))*BI(K,I)*DLX(I)`
			`else`
			`TFLUX = CBHE(JW)/RHOWCP*(TSED(JW)-T2(K,I))*(BI(K,I)-BI(K+1,I))*DLX(I)`
			`endif`
			
			New code added for sediment subroutine:
			`if(k == kb(i))then ! SW 4/18/07`
			`SEDAS(K,I) = SEDAS(K,I)+MAX(AS(JA),0.0)*ALG(K,I,JA)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`else`
			`SEDAS(K,I) = SEDAS(K,I)+MAX(AS(JA),0.0)*ALG(K,I,JA)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`endif`
			`if(k == kb(i))then ! SW 4/18/07`
			`SEDOMS(K,I) = POMS(JW)*(LPOM(K,I)+RPOM(K,I))*BI(K,I)/BH2(K,I)`
			`SEDSO = POMS(JW)*SED(K,I)*BI(K+1,I)/BH2(K,I)`
			`else`
			`SEDOMS(K,I) = POMS(JW)*(LPOM(K,I)+RPOM(K,I))*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`SEDSO = POMS(JW)*SED(K,I)*BI(K+1,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`endif`
				4/18/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

24	W2	Algae	The logic for negative settling velocities for algae had an error.
			Old code:
			`! ASR(K,I,JA) = -AS(JA)*(ALG(K+1,I,JA)*B(K+1,I)/(B(K,I)*H2(K,I))-ALG(K,I,JA))*BI(K,I)/BH2(K,I)`
			New code:
			`ASR(K,I,JA) = -AS(JA)*(ALG(K+1,I,JA)*BI(K+1,I)/BH2(K,I)-ALG(K,I,JA)*BI(K,I)/BH2(K,I))`
			`!SP 8/27/07`
			Shwet Prakash
				8/27/07